

CEQA PRELIMINARY HYDROLOGY/DRAINAGE STUDY FOR

**FUERTE RANCH ESTATES
TRACT NO. 5343**

COUNTY OF SAN DIEGO, CALIFORNIA

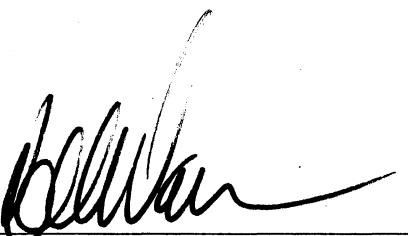
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I. PROJECT DESCRIPTION

This drainage report has been prepared to document the design and calculations for the proposed drainage system associated with the residential development of the Fuerte Ranch Estates project located in the Mount Helix Community of San Diego County. The project site is 27.3 acres in size and is bounded on the north, east and west by single-family residences, and on the south by Damon Lane County Park. The site is currently utilized as a chicken ranch and slopes gently from north to south with a disturbed natural drainage course bisecting the property.

The proposed design consists of 40 residential lots with a minimum lot size of $\frac{1}{2}$ acre. The existing drainage course is proposed to be reconstructed and realigned in order to improve its aesthetic and hydraulic characteristics. Vehicular access to the site is provided via Fuerte Drive on the north and Damon Lane on the west. Access within the subdivision is via public streets.

II. HYDROLOGY / HYDRAULICS METHODOLOGY

This drainage system has been designed in general conformance with the County of San Diego Hydrology Manual, 2003 Edition (H-Manual) and the San Diego County Drainage Design Manual (D-Manual). Drainage basins are less than one square mile, therefore, the Rational Method was utilized to calculate storm runoff. Runoff values for the 2-year, 50-year and 100-year storms were calculated, with the 100-year storm values being used to size the proposed conveyance and control facilities. Additionally:

- The runoff coefficients were calculated based on each drainage basin's percentage of impervious cover and the values from the "Runoff Coefficients for Urban Areas", Table 3-1 of the H-Manual (Soil Type 'D').
- Times of concentration for urban watersheds were calculated using the "Overland Time of Flow Nomograph", Figure 3-3 of the H-Manual, and the "Gutter and Roadway Discharge – Velocity Chart", Figure 3-6 of the H-Manual.
- Times of concentration for natural watersheds were calculated using the "Nomograph for Determination of Time of Concentration for Natural Watersheds", Figure 3-4 of the H-Manual.
- The intensities of rainfall were obtained from the "Intensity – Duration Design Chart", Figure 3-1 of the H-Manual, for each of the selected storm frequencies (2, 50 & 100-year).
- Inlets were sized based on non-routed flow values per Chapter 2 of the D-Manual.
- Manning's equation was used for swale, channel and pipe design and capacity analysis using 100-year storm runoff values.

III. EXISTING CONDITION DRAINAGE

The project site has housed a chicken ranch for the past 80 or so years. It contains 14 large chicken coops and several separate structures that serve as residential units and support buildings. Numerous tanks and wells also exist on the site. With the development of Fuerte Ranch Estates, all the existing structures will be removed from the project site.

The site slopes approximately 6% from the north to the south, with a minimum elevation of 536 MSL in the south and a maximum of 622 MSL in the north. The westerly 2/3's of the site (approximately) drains into the center of the project where the flows join with a drainage course that enters on the north side from Fuerte Drive. This drainage course flows into a man-made pond in the center of the project, where the flows are detained and then continue south through a disturbed natural channel. This disturbed channel exits on the south end of the property into the Damon Lane County Park. Portions of the pond and disturbed channel have been identified as ~~Resource Protection Ordinances (RPO)~~ wetlands, and as such may not be disturbed with the development of this project.

The easterly 1/3 of the site (approximately) drains to the south where the flow is joined by runoff from properties east of the site. These flows exit the property on the south end and are directed into an existing inlet located on the north side of Calle Albara. This inlet is part of the public drainage system associated with the Vista Dorada residential development, which directs its flow to the west and into the Damon Lane County Park.

As shown in Figure 2, the Existing Condition Drainage area has been divided into eight basins. Basin 'EX-1' collects runoff north of the site along Fuerte Drive and directs it onto the project site via 3 storm drain pipes under Fuerte Drive. This basin comprises 137.2 acres and has a 'c' factor of 0.43, resulting in a 100-year storm runoff value of 182.9 cfs (see Appendix 1 for hydrological calculations and Table 1 for a hydrology summary).

Basin 'EX-2' is also located north of the project site and collects runoff from properties north of Fuerte Drive. This runoff enters the project site via an 18" storm drain under Fuerte Drive just west of the 3 storm drain pipes mentioned in Basin 'EX-1'. Basin 'EX-2' comprises 9.8 acres and has a 'c' factor of 0.41, resulting in a 100-year storm runoff value of 18.5 cfs.

Basin 'EX-3' collects runoff from the residential areas located west of the project site across Damon Lane. This runoff is conveyed along the west side of Damon Lane and then crosses at a cross gutter near the southwest corner of the project site. This basin comprises 10.1 acres, has a 'c' factor of 0.49, and generates 23.8 cfs of 100-year storm runoff.

Basin 'EX-4' comprises the westerly 2/3's of the project site, totaling 19.7 acres. The runoff from this basin is conveyed through a disturbed natural channel in the center of the site, which continues to the south into Damon Lane County Park. A 'c' factor of 0.41 was calculated for this basin, resulting in a 100-year storm runoff value of 27.6 cfs.

Basin 'EX-5' collects runoff from the neighboring property to the northeast of the project site. This runoff enters the project and joins the flow from Basins 'EX-1' and 'EX-2' into the disturbed natural channel. This basin comprises 3.2 acres and has a 'c' factor of 0.46, resulting in a 100-year storm runoff value of 6.9 cfs.

Basin 'EX-6' is a large basin that collects runoff northeast of the project site along the east side of Fuerte Drive. This runoff is conveyed to the east side of the project site, where it enters the property through a rock-lined channel adjacent to a new asphalt road. This basin comprises 55.5 acres and has a 'c' factor of 0.41, resulting in a 100-year storm runoff value of 84.2 cfs.

Basin 'EX-7' comprises 3.6 acres of land adjacent to the eastern side of the project site. The runoff from this basin enters the property on the east, where it joins with the flow from Basin 'EX-6'. The 'c' factor for this basin was calculated to be 0.41, generating 6.3 cfs of storm runoff from the 100-year storm.

Basin 'EX-8' collects runoff from the easterly 1/3 of the site and directs it to the south. The flow from this basin joins with the flows from Basins 'EX-6' and 'EX-7', which are conveyed to the south into an existing drainage system in Calle Albara. This system discharges its flow into the natural channel in Damon Lane County Park. Basin 'EX-8' comprises 7.6 acres and has a 'c' factor of 0.41, resulting in a 100-year storm runoff value of 12.2 cfs.

The total Existing Condition 100-year storm runoff for the drainage basin is 345.6 cfs (see Appendix 4). This runoff enters the Damon Lane County Park and is conveyed to the south in a natural drainage course.

The existing off-site drainage courses that carry the flows described above have been in existence for at least 15 years and appear to have reached a stable condition. Based on the numbers calculated in this report and on several physical inspections, the existing drainage facilities appear to be adequate for the flows tributary to them. No erosion nor flooding issues were witnessed that would require remedial action. See Table 2 for a summary of the existing flow velocities exiting the site.

As mentioned earlier, the existing on-site drainage course that bisects the project site is a natural channel that has been disturbed by on-going operations related to the chicken ranch. Trash and debris block portions of the channel, and minor earth moving operations have resulted in a non-uniform channel cross section. From a hydraulic standpoint, the disturbed natural drainage course is not in an efficient state and should be recreated to provide a more stable, uniform conveyance facility.

IV. EXISTING PLUS PROPOSED CONDITION DRAINAGE

The Existing plus Proposed Condition Drainage has been divided into 3 main drainage basins, each with its own point of exit from the property. Basin 'A' is comprised of Sub-basins 'A1' thru 'A6'. Sub-basin 'A1' collects runoff from the east side of Damon Lane north of Fuerte

Farms Road. The contributing area for this sub-basin is 0.55 acres and, with a 'c' factor of 0.80, generates 2.2 cfs of 100-year storm runoff. This flow is conveyed along the east side of Damon Lane, where it enters a new curb inlet and is conveyed in a new 18" RCP. Sub-basins 'A2', 'A3', 'A4' and 'A5' collect on-site runoff from 7.25 acres, generating 18.9 cfs of 100-year storm runoff. This runoff joins with the runoff from Sub-basin 'A1' and together outlet at the south end of the project behind Lot 14. Sub-basin 'A6' and existing basin EX3 also outlet at this location, conveying their flows into the existing drainage course in the park.

The central portion of the proposed project site is part of Basin 'B', which is comprised of 7 sub-basins. Sub-basin 'B1' collects runoff from the south side of Fuerte Drive and conveys the flow into the existing drainage course at the northeast corner of the project via an existing asphalt downdrain. This sub-basin totals 0.18 acres, has a 'c' factor of 0.86, and generates 0.8 cfs of 100-year storm runoff.

Sub-basin 'B2' totals 1.81 acres, has a 'c' factor of 0.66, and generates 5.7 cfs of 100-year storm runoff. This runoff is collected in a new curb inlet and conveyed in a new 18" RCP.

Sub-basin 'B3' collects runoff from Lots 3-5 and Street 'B', comprising 1.76 acres. A 'c' factor of 0.50 was calculated for this sub-basin, resulting in a 100-year storm runoff value of 4.5 cfs. A new curb inlet captures this runoff and conveys it in a new 18" RCP with the flow from Sub-basin 'B2'.

Sub-basin 'B4' collects runoff from the east side of Street 'A' and Lots 38-40. This sub-basin totals 1.60 acres, has a 'c' factor of 0.55, and generates 4.0 cfs of 100-year storm runoff. The flow from this sub-basin is captured by a new curb inlet and conveyed into the existing sump via a new 18" RCP.

Sub-basin 'B5' comprises the reconstructed natural channel behind Lots 38-40 and the existing sump area. This sub-basin totals 0.85 acres and has a 'c' factor of 0.35. A 100-year storm runoff value of 1.3 cfs was calculated for this sub-basin. The flow from this sub-basin, and from basins EX1, EX2, and EX5, are conveyed in the reconstructed natural channel, which is designed as a vegetated channel with a 10-foot bottom width, 2.4-foot flow depth, and 3:1 side slopes. This flow exits into the existing sump area, which has been classified as an R.P.O. wetland protected area. Because of this classification, some portions of this area cannot be graded. Thus a slight sump condition will remain, with the outfall for this area being the proposed 72" RCP that directs the runoff to the south under Street 'C'.

Sub-basin 'B6' collects runoff from Lots 22 thru 24 and the cul-de-sac portion of Street 'C'. This sub-basin comprises 1.71 acres, has a 'c' factor of 0.53, and generates 3.5 cfs of 100-year storm runoff. This flow is captured in a new curb inlet and conveyed into the existing drainage course via a new 18" RCP.

Sub-basin 'B7' is comprised of Lot 21, the reconstructed channel behind Lots 18 & 19, and the existing drainage course behind Lots 15 thru 17. This sub-basin totals 2.09 acres, has a 'c' factor of 0.38, and generates 3.1 cfs of 100-year storm runoff. This runoff is initially conveyed in

a reconstructed vegetated channel with a 10-foot bottom width, 2.5-foot flow depth, and 3:1 side slopes. The flow then enters the existing drainage course, which is a heavily vegetated, varying width natural channel that continues into the County Park.

Sub-basins 'C1' thru 'C5' collect runoff from Lots 20 and 25 thru 37, as well as Street 'C'. These sub-basins total 7.99 acres and generate 18.2 cfs of 100-year storm runoff. This runoff is collected in new curb inlets and is conveyed in new 18" RCP's. The resultant flow from these basins is conveyed in a new 24" RCP that outlets into the proposed detention basin in the rear of Lots 23, 24 and 25.

Sub-basin 'C6' collects runoff from the rear of Lots 24 thru 31, totaling 0.78 acres and generating 1.8 cfs of 100-year storm runoff. The flow from this sub-basin and Basins EX6 and EX7 is conveyed in a new grass swale that directs the runoff to the south behind Lot 25. The flow at this point then exits the property to the south and into the existing drainage course, where it enters into the existing public drainage system along the north side of Calle Albara.

The total Existing plus Proposed Condition 100-year storm runoff for the entire drainage basin was calculated to be 366.3 cfs (see Appendix 5).

V. CONCLUSIONS

FLOW COMPARISON AND DETENTION

The total flow exiting the project site in the Existing Condition Drainage was calculated to be 345.6 cfs for the 100-year storm (routed). The same value for the Existing plus Proposed Condition Drainage was calculated to be 366.3 cfs (routed). This equates to an increase of 20.7 cfs for the 100-year storm event with the development of this project (~~19.2 cfs for the 50-year storm~~). In order to comply with the County of San Diego's requirement to maintain existing flow amounts leaving a project site after development, a detention basin will be incorporated within this project.

Two detention basins are proposed to handle the required detention volume as calculated in Appendix 6. These basins will detain the excess runoff from the ~~50~~100-year storm event (~~19.2~~ 20.7 cfs) and allow the 100-year storm runoff to bypass. One basin will be located in Lot 34, and the other in Lots 23, 24 & 25. The basin in Lot 34 is proposed to be 55-feet long, 30-feet wide, and 2.5-feet deep. This basin will outlet into the existing R.P.O. wetland sump area. The other detention basin, located in Lots 23, 24 & 25, is proposed to be 300-feet long, 15-feet wide, and 2.3-feet deep. This basin will outlet onto the County Park property through a flow dispersion device. Thus the ~~50~~100-year runoff leaving the site in the Existing plus Proposed Condition will equal the runoff leaving the site in the Existing Condition.

EXIT VELOCITIES

As shown in Table 2, the exit velocities for the Existing Condition are values that would not induce erosive actions within their conveyance facilities (less than 5 feet-per-second). The Existing plus Proposed Condition produces similar exit velocities for the identical exit points.

The slight increases shown between the two conditions are negligible (4% and 6%) and should not affect the downstream drainage characteristics in any measurable way.

DOWNSTREAM DRAINAGE

As stated earlier, there does not appear to be any pre-existing flooding or erosion issues present in the downstream drainage courses that serve this project site. Since this project will not be increasing flow into the downstream drainage courses, flooding and erosion issues should not be created with the development of this project. Likewise, as shown in Table 2, the exit velocities of the discharge points exiting the site are all under 5.0 feet-per-second, resulting in non-erosive flow. Thus, downstream mitigation measures are not necessary.

As shown on Figure 3, the Existing plus Proposed Condition Drainage does not divert drainage from one basin to another. In addition, flow dispersion devices will be designed during the final engineering stage that will ensure that the flow outlet points are not concentrating flows in an erosive manner. Since the downstream flow characteristics will not be impacted by the proposed development, Waiver and Release Agreements from downstream property owners should not be required by the County Department of Public Works.

WATER QUALITY

This project proposes to incorporate several water quality improvement features that will encourage cleansing of the stormwater prior to leaving the site. Some basins will convey their runoff in grass-lined swales or vegetated channels that will allow solids and pollutants to infiltrate or settle-out prior to entering the storm drain system. All inlets will be provided with filter inserts that will also prevent solids and pollutants from joining the storm flows. Additionally, the proposed detention basins will allow for runoff infiltration and will capture trash and pollutants before they have a chance to leave the site and pollute downstream drainage courses.

DRAINAGE FACILITY MAINTENACE

Due to the numerous drainage facilities proposed for this subdivision, a maintenance mechanism needs to be established with this project to address the long-term care and maintenance of these facilities. This project proposes to create a maintenance assessment district that each homeowner within this project will be a participant. This district will collect fees from each homeowner to manage, maintain, repair and replace any items related to the following common facilities:

- a) Grass swales.
- b) Vegetated channels that collect on and off-site drainage and convey it across 2 or more lots (cross-lot drainage).
- c) The detention basin(s).
- d) The wetland buffer areas.
- e) The RPO wetland areas.
- f) Filter inserts for the public inlets and catch basins.

The specifics of the maintenance assessment district to be formed will be detailed more thoroughly in the final engineering/mapping stage of the project.

CEQA QUESTIONING

#1 *Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on-or off-site?*

As detailed earlier in this document, the proposed project will not substantially alter the existing drainage pattern in this area. Slight modifications will be made to some of the on-site drainage patterns, but these have no effect on the overall drainage design of this area as a whole. This project does propose to alter the existing drainage path that bisects the site by reconstructing and realigning a portion of the existing channel on-site. This is being done to provide a more direct path for the runoff and to locate the channel in a more suitable location. As shown in Appendix 3, the proposed channel will not possess velocities that are considered erosive (less than 5 fps), nor that will encourage siltation (less than 2 fps). Also, as shown in Table 2, the exit velocity for the Existing plus Proposed Condition at the runoff points of exit from the project also do not exceed velocities that are considered erosive (4.7 fps max.). The proposed exit velocities are roughly equal to the existing velocities, which will keep the downstream drainage courses in their current state of equilibrium. Lastly, the project will landscape any areas that are to be graded or are bare in their current state. This will help to reduce the sediment load in the existing and proposed drainage courses. Thus the proposed project will not result in substantial erosion or siltation on- or off-site.

#2 *Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?*

The proposed project will be constructed with appropriately sized capture and conveyance facilities that will reduce the likelihood of flooding on-site. These facilities have been designed to handle a 100-year storm, and with the inherent redundancies built into the capacity calculations, these facilities will most likely handle storms larger than the 100-year event. In addition, most of the runoff on-site will drain towards the proposed channel, so should some drainage facilities fail for whatever reason, the excess runoff will enter the channel. Since the proposed channel has sufficient freeboard within its banks, it can accommodate flows in addition to its calculated 100-year runoff value. Flooding off-site is not likely either due to the proposed detention basins on-site. These basins will detain proposed peak flows so that runoff amounts leaving the site in the proposed condition will be approximately equal to those leaving the site in the existing condition. Since there do not appear to be any existing flooding issues in the existing condition, there should be none created with the development of this project.

#3 *Would the project create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems?*

The proposed project will not create nor contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems. As previously mentioned, the project will incorporate two detention basins that will detain peak flows and restrict exiting flows to leave the site at their pre-development values. Since the existing drainage facilities in the

vicinity of this project are adequate to handle the existing flows, they will also be adequate to handle the existing plus proposed flows.

#4 Would the project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps?

The proposed project will not place housing within a 100-year flood hazard area. This was verified by checking the County of San Diego Floodplain Maps, which showed no floodplain in the vicinity of this project, and by viewing the FEMA Flood Insurance Rate Maps (FIRM), which determined the project to be outside of the 500-year floodplain. In fact, the FIRM panel for this project vicinity (panel 1644) has not been printed since it only contains areas outside of the 500-year floodplain.

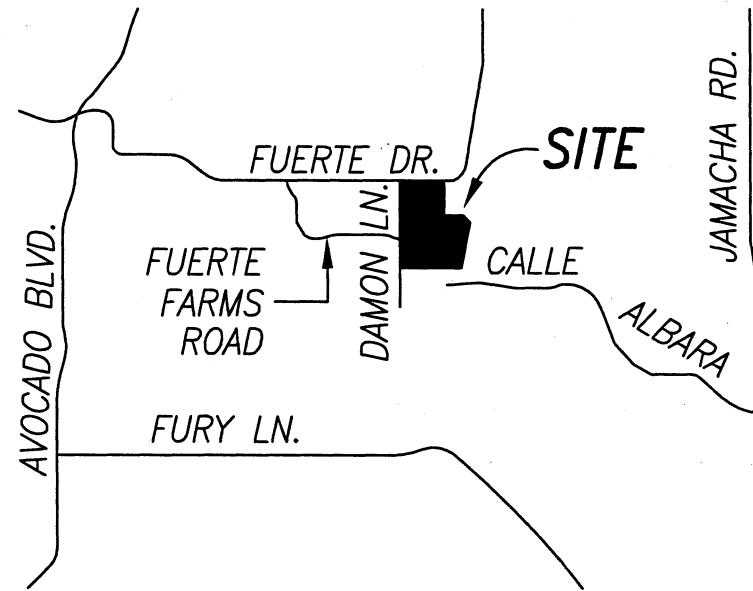
#5 Would the project place within a 100-year flood hazard area structures which would impede or redirect flood flows?

The proposed project will not place within a 100-year flood hazard area structures which would impede or redirect flood flows. As stated in Question 4, the proposed project does not contain any areas within a 100-year flood hazard area. All portions of the proposed project are located outside of the 500-year floodplain, per FIRM panel 1644.

#6 Would the project expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam on-site or off-site?

There are no dams or levees proposed for this project, nor are there any dams or levees located upstream of this project. Thus this project will not expose people or structures to a significant risk of loss, injury or death as a result of a dam or levee failure. In addition, this project should not create any significant flooding issues, as discussed in Question #2.

FIGURE 1



VICINITY MAP

NO SCALE

TABLE 1 HYDROLOGY SUMMARY

EXISTING CONDITION												
BASIN NUMBER	AREA (acres)	C	L (ft.)	S (%) Heff	Tc (min.)	I ₂ (in/hr)	I ₅₀ (in/hr)	I ₁₀₀ (in/hr)	Q ₂ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)	COMMENTS
EX-1	137.2	0.43	3,900	5.4	17.93	1.3	2.9	3.1	76.7	171.1	182.9	
EX-2	9.8	0.41	1,150	7.4	9.80	1.9	4.3	4.6	7.6	17.3	18.5	
EX-3	10.1	0.49	1,200	7.1	9.11	2.0	4.5	4.8	9.9	22.3	23.8	
EX-4	19.7	0.41	1,820	5.0	15.53	1.4	3.2	3.4	11.3	25.8	27.6	(on-site basin)
EX-5	3.2	0.46	480	5.2	9.56	1.9	4.3	4.7	2.8	6.3	6.9	
EX-6	55.5	0.41	2,770	5.7	13.93	1.5	3.4	3.7	34.1	77.4	84.2	
EX-7	3.6	0.41	1,350	7.1	10.76	1.8	4.0	4.3	2.7	5.9	6.3	
EX-8	7.6	0.41	860	4.1	12.92	1.6	3.6	3.9	5.0	11.2	12.2	(on-site basin)
TOTAL	302.2											362.4
	27.3											345.6 Routed
EXISTING PLUS PROPOSED CONDITION												
BASIN NUMBER	AREA (acres)	C	L (ft.)	S (%) Heff	Tc (min.)	I ₂ (in/hr)	I ₅₀ (in/hr)	I ₁₀₀ (in/hr)	Q ₂ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)	COMMENTS
A1	0.55	0.80	800	8.0	8.65	2.04	4.63	5.00	0.9	2.0	2.2	
A2	1.27	0.53	400	5.6	8.20	2.11	4.79	5.17	1.4	3.2	3.5	
A3	1.64	0.53	490	5.8	8.47	2.06	4.69	5.06	1.8	4.1	4.4	
A4	1.06	0.50	290	5.8	7.73	2.19	4.97	5.37	1.2	2.6	2.8	
A5	3.28	0.55	395	2.8	9.94	1.86	4.23	4.57	3.4	7.6	8.2	
A6	0.68	0.70	665	3.8	10.45	1.80	4.09	4.42	0.9	1.9	2.1	
B1	0.18	0.86	240	5.0	7.92	2.15	4.90	5.29	0.3	0.8	0.8	
B2	1.81	0.66	675	5.2	9.21	1.95	4.44	4.80	2.3	5.3	5.7	
B3	1.76	0.50	525	6.1	8.29	2.09	4.75	5.13	1.8	4.2	4.5	
B4	1.60	0.55	535	3.7	9.93	1.86	4.23	4.57	1.6	3.7	4.0	
B5	0.85	0.35	595	5.4	11.37	1.70	3.90	4.20	0.5	1.2	1.3	
B6	1.71	0.53	400	1.0	12.70	1.59	3.61	3.90	1.4	3.3	3.5	
B7	2.09	0.38	735	4.4	12.74	1.60	3.60	3.90	1.3	2.9	3.1	
C1	2.84	0.55	820	2.5	12.03	1.65	3.74	4.04	2.6	5.8	6.3	
C2	1.41	0.57	655	2.5	11.53	1.69	3.84	4.15	1.4	3.1	3.3	
C3	1.28	0.55	550	2.5	11.12	1.73	3.93	4.25	1.2	2.8	3.0	
C4	1.02	0.52	385	2.5	10.43	1.80	4.10	4.40	1.0	2.2	2.3	
C5	1.44	0.52	470	2.5	10.75	1.77	4.02	4.34	1.4	3.1	3.3	
C6	0.78	0.64	1020	3.6	13.51	1.50	3.50	3.70	0.7	1.7	1.8	
TOTAL	27.3											66.4
TOTAL EXISTING PLUS PROPOSED CONDITION 100-YEAR FLOW (ROUTED)												
TOTAL EXISTING CONDITION 100-YEAR FLOW (ROUTED)												
									DIFFERENCE	20.7	100-YEAR	
										19.2	50-YEAR	

TABLE 2 EXIT VELOCITY SUMMARY

CONVEYANCE LOCATION	STRUCTURE AREA	EXISTING CONDITION			PROPOSED CONDITION		
		100-YEAR FLOW	100-YEAR VELOCITY	100-YEAR FLOW	100-YEAR VELOCITY	DIFFERENCE	
South of Lot 14 ^A	Natural Channel	72.0 sf	244.4 cfs	3.4	260.1	3.6	+0.2 (+6%)
South of Lot 25 ^B	Natural Channel	22.5 sf	101.2	4.5	106.2	4.7	+0.2 (+4%)

^A Exit point for Basins EX1, EX2, EX3, EX4, EX5, A & B^B Exit point for Basins EX6, EX7, EX8 & C

APPENDIX 1

HYDROLOGICAL CALCULATIONS – EXISTING CONDITION

HYDROLOGY CALCS

EXISTING CONDITION

BASIN EX-1

$$\underline{A = 137.2 \text{ AC}}$$

SOIL TYPE = 'D'

$$C = 0.10(0.35) + 0.30(0.41) + 0.60(0.46)$$

(10% UNDISTURBED, 30% 1Dw/AC, 60% 2Dw/AC)

$$\underline{C = 0.43}$$

$$\underline{L = 3900'}$$

$$\text{SLOPE} = \frac{800 - 590}{3900} = \underline{5.38\%}$$

$$T_c = T_i + T_f$$

$$T_i = \frac{8.8 \text{ min.}}{\text{LDR } 204/\text{AC}} \quad (\text{TABLE 3-2: } L_m = 100', S = 5\%)$$

$$T_f = \left(\frac{11.9 L^3}{\Delta E} \right)^{.385} \quad \begin{aligned} L &= 3900 - 100 = 3,800' \\ \Delta E &= 0.72 \text{ mi.} \\ &= 590' \end{aligned}$$

$$T_f = \left(\frac{11.9 (.72)^3}{590} \right)^{.385} \times 60$$

$$T_f = 9.13 \text{ min.}$$

$$\underline{T_c = T_i + T_f = 8.8 + 9.13 = 17.93 \text{ min.}}$$

$$\begin{aligned} I_2 &= 7.44 P_{62} T_c^{-.645} \\ &= 7.44 (1.1) 17.93^{-.645} \end{aligned}$$

$$\underline{I_2 = 1.3 \text{ in/HR}}$$

$$I_{50} = 7.44 P_{650} T_c^{-0.645}$$

$$= 7.44(2.5) 17.93^{-0.645}$$

$$\underline{I_{50} = 2.9 \text{ in/HR}}$$

$$I_{100} = 7.44 P_{6100} T_c^{-0.645}$$

$$= 7.44(2.7) 17.93^{-0.645}$$

$$\underline{I_{100} = 3.1 \text{ in/HR}}$$

$$Q_2 = CA I_2$$

$$= (0.43)(137.2)(1.3)$$

$$\underline{Q_2 = 76.7 \text{ cfs}}$$

$$Q_{50} = CA I_{50}$$

$$= (0.43)(137.2)(2.9)$$

$$\underline{Q_{50} = 171.1 \text{ cfs}}$$

$$Q_{100} = CA I_{100}$$

$$= (0.43)(137.2)(3.1)$$

$$\underline{Q_{100} = 182.9 \text{ cfs}}$$

BASIN EX-2

$$A = 9.8 \text{ AC}$$

$$\text{Soil Type} = 'D'$$

$$C = 0.41 \text{ (100/AC)}$$

$$L = 1,150'$$

$$S = \frac{685 - 600}{1,150} = 7.4\%$$

$$T_C = T_i + T_f$$

$$T_i = 7.4 \text{ min (100/AC, } S = 7\%, L_u = 100')$$

$$\text{Assume } V = 4.0 \text{ FPS}$$

$$T_f = 1,050 \div (4.0 \times 60) = 4.38 \text{ min.}$$

$$T_C = T_i + T_f = 7.4 + 4.4 = 11.8 \text{ min.}$$

$$I_{50} = 7.44(2.5) 11.8^{-0.645} = 3.78 \text{ in/HR}$$

$$Q_{50} = CAI_{50} = (0.41)(9.8)(3.78) = 15.2 \text{ CFS}$$

$$\text{FROM FIGURE 3-6} \rightarrow V = 7.3 \text{ FPS}$$

$$T_f = 1,050 \div (7.3 \times 60) = 2.40 \text{ min.}$$

$$T_C = 7.4 + 2.4 = 9.8 \text{ min.}$$

$$I_2 = 7.44(1.1) 9.8^{-0.645} = 1.9 \text{ in/HR}$$

$$I_{50} = 7.44(2.5) 9.8^{-0.645} = 4.3 \text{ in/HR}$$

$$I_{100} = 7.44(2.7) 9.8^{-0.645} = 4.6 \text{ in/HR}$$

$$Q_2 = CAI_2 = (0.41)(9.8)(1.9) = 7.6 \text{ CFS}$$

$$Q_{50} = CAI_{50} = (0.41)(9.8)(4.3) = 17.3 \text{ CFS}$$

$$Q_{100} = CAI_{100} = (0.41)(9.8)(4.6) = 18.5 \text{ CFS}$$

BASIN EX-3)

$$A = 10.1 \text{ ac}$$

(soc rate 'b')

$$C = 0.1(0.79) + 0.9(0.46) = \underline{0.49}$$

(10% COMMERCIAL (SCHOOL) & 90% 2 DU/AC)

$$L = 1,200'$$

$$\text{SLOPE} = \frac{625 - 540}{1,200} = \underline{7.1\%}$$

$$T_c = T_i + T_f$$

$$T_i = 6.7 \text{ min. (TABLE 3-2)} L_m = 100'$$

Assume $V = 7.0 \text{ FPS}$

$$T_f = 1,200 - 100 \div (7.0 \times 60) = 2.62 \text{ min.}$$

$$T_c = T_i + T_f = 6.7 + 2.62 = 9.32 \text{ min.}$$

$$I_{50} = 7.44(2.5) 9.32^{-0.645} = 4.4 \text{ in/hr}$$

$$Q_{50} = CAI_{50} = (0.49)(10.1)(4.4) = 21.8 \text{ cfs}$$

FROM FIGURE 3-6 $\rightarrow V = 7.6 \text{ FPS}$

$$T_f = 1,200 - 100 \div (7.6 \times 60) = \underline{2.41 \text{ min.}}$$

$$T_c = T_i + T_f = 6.7 + 2.41 = \underline{9.11 \text{ min.}}$$

$$I_2 = 7.44(1.1) 9.11^{-0.645} = \underline{2.0 \text{ in/hr}}$$

$$I_{50} = 7.44(2.5) 9.11^{-0.645} = \underline{4.5 \text{ in/hr}}$$

$$I_{100} = 7.44(2.7) 9.11^{-0.645} = \underline{4.8 \text{ in/hr}}$$

$$Q_2 = CAI_2 = (0.49)(10.1)(2.0) = \underline{9.9 \text{ cfs}}$$

$$Q_{50} = CAI_{50} = (0.49)(10.1)(4.5) = \underline{22.3 \text{ cfs}}$$

$$Q_{100} = CAI_{100} = (0.49)(10.1)(4.8) = \underline{23.8 \text{ cfs}}$$

BASIN EX-4) (ON-SITE)

$$\underline{A = 19.7 \text{ AC}}$$

$$\text{SOIL TYPE} = 'D'$$

$$\underline{C = 0.41 \text{ (} 100/\text{AC OR LESS)}}$$

$$\underline{L = 1,820'}$$

$$\text{SLOPE} = \frac{620 - 530}{1,820} = \underline{5.0\%}$$

$$T_c = T_i + T_f$$

$$\underline{T_i = 8.0 \text{ min. (TABLE 3-2) } L_m = 100'}$$

$$\underline{T_f = \left[11.9 \left(\frac{1720}{5280} \right)^3 \right]^{.385} \times 60 = 7.53 \text{ min.}}$$

$$\underline{T_c = T_i + T_f = 8.0 + 7.53 = 15.53 \text{ min.}}$$

$$\underline{I_2 = 2.44(1.1)(15.53)^{-0.645} = 1.40 \text{ in/HR}}$$

$$\underline{I_{50} = 2.44(2.5)(15.53)^{-0.645} = 3.20 \text{ in/HR}}$$

$$\underline{I_{100} = 2.44(2.7)(15.53)^{-0.645} = 3.42 \text{ in/HR}}$$

$$\underline{Q_2 = CAI_2 = (0.41)(19.7)(1.40) = 11.3 \text{ cfs}}$$

$$\underline{Q_{50} = CAI_{50} = (0.41)(19.7)(3.20) = 25.8 \text{ cfs}}$$

$$\underline{Q_{100} = CAI_{100} = (0.41)(19.7)(3.42) = 27.6 \text{ cfs}}$$

BASIN EX-5

$$\underline{A = 3.2 \text{ ac}}$$

SOIL TYPE = 'D'

$$\underline{C = 0.46 \text{ (2 cu/ac)}}$$

$$\underline{L = 480'}$$

$$S = \frac{595 - 520}{480'} = \underline{5.2\%}$$

$$T_c = T_i + T_f$$

$$\underline{T_i = 7.4 \text{ min. (TABLE 3-2)}} \quad L_m = 100'$$

$$T_f = \left[\frac{11.9 \left(\frac{380}{5280} \right)^3}{25} \right]^{.385} \times 60 = \underline{2.16 \text{ min.}}$$

$$\underline{T_c = 7.4 + 2.16 = 9.56 \text{ min.}}$$

$$\underline{I_2 = (0.44)(1.1)(9.56)^{-0.645} = 1.9 \text{ in/HR}}$$

$$\underline{I_{50} = (0.44)(2.5)(9.56)^{-0.645} = 4.3 \text{ in/HR}}$$

$$\underline{I_{100} = (0.44)(2.7)(9.56)^{-0.645} = 4.7 \text{ in/HR}}$$

$$\underline{Q_2 = CAI_2 = (0.46)(3.2)(1.9) = 2.8 \text{ cfs}}$$

$$\underline{Q_{50} = CAI_{50} = (0.46)(3.2)(4.3) = 6.3 \text{ cfs}}$$

$$\underline{Q_{100} = CAI_{100} = (0.46)(3.2)(4.7) = 6.9 \text{ cfs}}$$

BASIN EX-6

$$A = 55.5 \text{ ac}$$

SOC TYPE = 'D'

$$C = 0.41 \quad (100/\text{ac})$$

$$L = 2,770'$$

$$S = \frac{723 - 565}{2,770} = 5.7\%$$

$$T_c = T_i + T_f$$

$$T_i = 8.0 \text{ min. (TABLE 3-2)} \quad L_m = 100'$$

Assume $V = 6.5 \text{ FPS}$

$$T_f = 2670 \div (6.5 \times 60) = 6.85 \text{ min.}$$

$$T_c = 8.0 + 6.85 = 14.85 \text{ min.}$$

$$I_{50} = (7.44)(2.5)(14.85)^{-0.645} = 3.3 \text{ in/hr}$$

$$Q_{50} = CAI_{50} = (0.41)(55.5)(3.3) = 75.1 \text{ cfs}$$

FROM FIGURE 3-6 $\rightarrow V = 7.5 \text{ FPS}$

$$T_f = 2670 \div (7.5 \times 60) = 5.93 \text{ min.}$$

$$T_c = 8.0 + 5.93 = 13.93 \text{ min.}$$

$$I_2 = (7.44)(1.1)(13.93)^{-0.645} = 1.50 \text{ in/hr}$$

$$I_{50} = (7.44)(2.5)(13.93)^{-0.645} = 3.40 \text{ in/hr}$$

$$I_{100} = (7.44)(2.7)(13.93)^{-0.645} = 3.70 \text{ in/hr}$$

$$Q_2 = CAI_2 = (0.41)(55.5)(1.50) = 34.1 \text{ cfs}$$

$$Q_{50} = CAI_{50} = (0.41)(55.5)(3.40) = 77.4 \text{ cfs}$$

$$Q_{100} = CAI_{100} = (0.41)(55.5)(3.70) = 84.2 \text{ cfs}$$

BASIN EX-7

$$\underline{A = 3.6 \text{ AC}}$$

SOIL TYPE = 'D'

$$\underline{C = 0.41 \text{ (100/AC)}}$$

$$\underline{L = 1,350'}$$

$$S = \frac{655 - 560}{1,350} = \underline{7.1\%}$$

$$\bar{T}_c = T_i + T_f$$

$$T_i = 7.4 \text{ min. (TABLE 3-2)} L_m = 100'$$

ASSUME $V = 7.5 \text{ FPS}$

$$T_f = 1250 \div (7.5 \times 60) = \underline{2.78 \text{ min.}}$$

$$\bar{T}_c = 7.4 + 2.78 = \underline{10.18 \text{ min.}}$$

$$I_{50} = (7.44)(2.5)(10.18)^{-0.645} = \underline{4.2 \text{ in/hr}}$$

$$Q_{50} = CAI_{50} = (0.41)(3.6)(4.2) = \underline{6.2 \text{ cfs}}$$

FROM FIGURE 3-6 $\rightarrow V = \underline{6.2 \text{ FPS}}$

$$T_f = 1250 \div (6.2 \times 60) = \underline{3.36 \text{ min.}}$$

$$\bar{T}_c = 7.4 + 3.36 = \underline{10.76 \text{ min.}}$$

$$I_2 = (7.44)(1.1)(10.76)^{-0.645} = \underline{1.8 \text{ in/hr}}$$

$$I_{50} = (7.44)(2.5)(10.76)^{-0.345} = \underline{4.0 \text{ in/hr}}$$

$$I_{100} = (7.44)(2.7)(10.76)^{-0.345} = \underline{4.3 \text{ in/hr}}$$

$$Q_2 = CAI_2 = (0.41)(3.6)(1.8) = \underline{2.7 \text{ cfs}}$$

$$Q_{50} = CAI_{50} = (0.41)(3.6)(4.0) = \underline{5.9 \text{ cfs}}$$

$$Q_{100} = CAI_{100} = (0.41)(3.6)(4.3) = \underline{6.3 \text{ cfs}}$$

BASIN EX-8

$$\underline{A = 7.6 \text{ ac}}$$

Soil type = 'D'

$$\underline{C = 0.41 \text{ (106/ac)}}$$

$$\underline{L = 860'}$$

$$S = \frac{575 - 540}{860'} = \underline{4.1\%}$$

$$\underline{T_c = T_i + T_f}$$

$$T_i = 8.7 \text{ min. (TABLE 3-2)} \quad (n = 100)$$

$$T_f = \left[\frac{11.9 \left(\frac{760}{5280} \right)^3}{35} \right]^{.385} \times 60 = \underline{4.22 \text{ min.}}$$

$$\underline{T_c = 8.7 + 4.22 = 12.92 \text{ min.}}$$

$$\underline{I_2 = (7.44)(1.1)(12.92)^{-0.645} = 1.6 \text{ cfs}}$$

$$\underline{I_{50} = (7.44)(2.5)(12.92)^{-0.645} = 3.6 \text{ cfs}}$$

$$\underline{I_{100} = (7.44)(2.7)(12.92)^{-0.645} = 3.9 \text{ cfs}}$$

$$\underline{Q_2 = CAI_2 = (0.41)(7.6)(1.6) = 5.0 \text{ cfs}}$$

$$\underline{Q_{50} = CAI_{50} = (0.41)(7.6)(3.6) = 11.2 \text{ cfs}}$$

$$\underline{Q_{100} = CAI_{100} = (0.41)(7.6)(3.9) = 12.2 \text{ cfs}}$$

APPENDIX 2

HYDROLOGICAL CALCULATIONS – EXISTING PLUS PROPOSED CONDITION

HYDROLOGY CALC'S

EXISTING + PROPOSED CONDITION

BASIN A1

$$A = 0.55 \text{ ac}$$

SOC TYPE 'D'

$$C = 0.9(0.78) + 0.46(1-0.78) = \underline{0.80}$$

(78% IMPERV. SURF.; 22% 2 DU/AC)

$$L = 800'$$

$$S = \frac{625 - 561}{800} = 8.0\%$$

$$T_c = T_i + T_r$$

$$T_i = 6.6 \text{ min. (2 DU/AC)} \quad L_m = 100'$$

$$\text{Assume } V_{50} = 6.0 \text{ fpm}$$

$$T_r = \frac{800 - 100}{6.0(60)} = 1.94 \text{ min.}$$

$$T_c = 6.6 + 1.94 = 8.54 \text{ min.}$$

$$I_{50} = (7.44)(2.5) 8.54^{-0.645} = 4.66 \text{ in/Hr}$$

$$Q_{50} = CAI_{50} = (0.80)(0.55)(4.66) = 2.1 \text{ cfs}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = 5.7 \text{ fpm}$

$$T_r = \frac{700}{5.7 \cdot 60} = 2.05 \text{ min.}$$

$$T_c = 6.6 + 2.05 = \underline{8.65 \text{ min.}}$$

$$I_2 = (7.44)(1.1) 8.65^{-0.645} = 2.04 \text{ in/Hr}$$

$$I_{50} = (7.44)(2.5) 8.65^{-0.645} = 4.63 \text{ in/Hr}$$

$$I_{100} = (7.44)(2.7) 8.65^{-0.645} = 5.00 \text{ in/Hr}$$

$$Q_2 = CAI_2 = (0.80)(0.55)(2.04) = 0.9 \text{ cfs}$$

$$Q_{50} = CAI_{50} = (0.80)(0.55)(4.63) = 2.0 \text{ cfs}$$

$$Q_{100} = CAI_{100} = (0.80)(0.55)(5.00) = 2.2 \text{ cfs}$$

BASIN A2

$$A = 1.27 \text{ ac}$$

SOIL TYPE 'D'

$$C = 0.9(0.15) + 0.46(0.85) = 0.53$$

(15% IMPERV.; 85% DOW/AC)

$$L = 400'$$

$$S = 5.6^\circ$$

$$T_i = 7.2 \text{ min. } (L_a = 100')$$

ASSUME $V_{50} = 5.0 \text{ FPS}$

$$T_f = \frac{400 - 100}{50 \cdot 60} = 1.00 \text{ min.}$$

$$T_c = 7.2 + 1.00 = 8.20 \text{ min.}$$

$$I_{50} = (7.44)(2.5) 8.20^{-0.645} = 4.79 \text{ in/Hr}$$

$$Q_{50} = CA I_{50} = 0.53(1.27)(4.79) = 3.2 \text{ CFS}$$

FROM FIG. 3-6 $\rightarrow V_{50} = 5.0 \text{ FPS}$

$$T_c = 8.20 \text{ min.}$$

$$I_2 = (7.44)(1.1) 8.20^{-0.645} = 2.11 \text{ in/Hr}$$

$$I_{50} = (7.44)(2.5) 8.20^{-0.645} = 4.79 \text{ in/Hr}$$

$$I_{100} = (7.44)(2.7) 8.20^{-0.645} = 5.11 \text{ in/Hr}$$

$$Q_2 = (0.53)(1.27)(2.11) = 1.4 \text{ CFS}$$

$$Q_{50} = (0.53)(1.27)(4.79) = 3.2 \text{ CFS}$$

$$Q_{100} = (0.53)(1.27)(5.11) = 3.5 \text{ CFS}$$

BASIN A3

$$A = 164 \text{ ac}$$

SOURCE D)

$$C = 0.9(.15) + 0.46(1-0.15) = 0.53$$

(15% IMPERV. SURF.; 85% 2DUR/AC)

$$L = 490'$$

$$S = 5.8\%$$

$$T_i = 7.2 \text{ min. } (Lm = 100')$$

ASSUME $V_{50} = 6.0 \text{ FPS}$

$$T_f = \frac{490-100}{6.00} = 1.08 \text{ min.}$$

$$T_c = 7.2 + 1.08 = 8.28 \text{ min.}$$

$$I_{50} = (7.44)(2.5)(8.28)^{-0.645} = 4.75 \text{ in/hr}$$

$$Q_{50} = CAI_{50} = (0.53)(1.64)(4.75) = 4.1 \text{ CFS}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = 5.1 \text{ FPS}$

$$T_f = \frac{490-100}{5.1 \cdot 60} = 1.27 \text{ min.}$$

$$T_c = 7.2 + 1.27 = 8.47 \text{ min.}$$

$$\frac{I_2}{I_{50}} = \frac{(7.44)(1.1)(8.47)^{-0.645}}{(7.44)(2.5)(8.28)^{-0.645}} = \frac{2.06 \text{ in/hr}}{4.69 \text{ in/hr}}$$

$$\frac{I_{100}}{I_{50}} = \frac{(7.44)(2.7)(8.47)^{-0.645}}{(7.44)(2.5)(8.28)^{-0.645}} = \frac{5.06 \text{ in/hr}}{4.69 \text{ in/hr}}$$

$$Q_2 = (0.53)(1.64)(2.06) = 1.8 \text{ CFS}$$

$$Q_{50} = (0.53)(1.64)(4.69) = 4.1 \text{ CFS}$$

$$Q_{100} = (0.53)(1.64)(5.06) = 4.4 \text{ CFS}$$

BASIN A4

$$A = 1.06 \text{ ac}$$

SOC TYPE 'D'

$$C = 0.9(0.10) + 0.46(1.0 - 0.1) = \underline{0.50}$$

(10% IMPERV. SURF.; 90% DUR/SC)

$$L = 290'$$

$$S = 5.80\%$$

$$T_i = 7.1 \text{ min.} \quad (L_m = 100')$$

ASSUME $V_{50} = 5.8 \text{ FPS}$

$$T_f = \frac{290 - 100}{5.8 \cdot 60} = 0.55 \text{ min.}$$

$$T_c = 7.1 + 0.55 = 7.65 \text{ min.}$$

$$I_{50} = (7.44)(2.5)(7.65)^{-0.645} = 5.01 \text{ in/HR}$$

$$Q_{50} = CA I_{50} = (0.50)(1.06)(5.01) = 2.7 \text{ FPS}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = \underline{5.0 \text{ FPS}}$

$$T_f = \frac{290 - 100}{50 \cdot 60} = 0.63 \text{ min.}$$

$$T_c = 7.1 + 0.63 = \underline{7.73 \text{ min.}}$$

$$I_2 = (7.44)(1.1)(7.73)^{-0.645} = \underline{2.19 \text{ in/HR}}$$

$$I_{50} = (7.44)(2.5)(7.73)^{-0.645} = \underline{4.97 \text{ in/HR}}$$

$$I_{100} = (7.44)(2.7)(7.73)^{-0.645} = \underline{5.37 \text{ in/HR}}$$

$$Q_2 = (0.50)(1.06)(2.19) = \underline{1.2 \text{ CFS}}$$

$$Q_{50} = (0.50)(1.06)(4.97) = \underline{2.6 \text{ CFS}}$$

$$Q_{100} = (0.50)(1.06)(5.37) = \underline{2.8 \text{ CFS}}$$

BASIN A5

$$\underline{A = 3.28 \text{ AC}}$$

SOIL TYPE D'

$$\underline{C = 0.9(0.2) + 0.46(1.0 - 0.2) = 0.55}$$

(20% IMPERV.; 80% 20U/AC)

$$L = 395'$$

$$S = 2.8\%$$

$$T_i = 8.8 \text{ min. } (L_m = 100')$$

ASSUME $V_{50} = 4.0 \text{ FPM}$

$$T_f = \frac{395 - 100}{4.3 \cdot 60} = 1.23 \text{ min.}$$

$$T_c = 8.8 + 1.23 = 10.03 \text{ min.}$$

$$I_{50} = (7.44)(2.5) 10.03^{-645} = 4.20 \text{ in/HR}$$

$$Q_{50} = CAI_{50} = (0.55)(3.28)(4.20) = 7.6 \text{ CFS}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = 4.3 \text{ FPM}$

$$T_f = \frac{395 - 100}{4.3 \cdot 60} = 1.14 \text{ min.}$$

$$T_c = 8.8 + 1.14 = 9.94 \text{ min.}$$

$$I_2 = (7.44)(1.1) 9.94^{-645} = 1.86 \text{ in/HR}$$

$$I_{50} = (7.44)(2.5) 9.94^{-645} = 4.23 \text{ in/HR}$$

$$I_{100} = (7.44)(2.7) 9.94^{-645} = 4.57 \text{ in/HR}$$

$$Q_2 = (0.55)(3.28)(1.86) = 3.4 \text{ CFS}$$

$$Q_{50} = (0.55)(3.28)(4.23) = 7.6 \text{ CFS}$$

$$Q_{100} = (0.55)(3.28)(4.57) = 8.2 \text{ CFS}$$

BASIN A6

$$A = 0.68 \text{ AC}$$

SOIL TYPE 'D'

$$C = 0.9(0.55) + 0.46(1-0.55) = 0.70$$

(55% IMP.; 45% ZDU/AC)

$$L = 665'$$

$$S = \frac{562 - 537}{665} = 3.8\%$$

$$T_f = 8.1 \text{ min. } (L_m = 100')$$

ASSUME $V_{50} = 5.5 \text{ FPS}$

$$T_f = \frac{665 - 100}{5.5 \cdot 60} = 1.71 \text{ min.}$$

$$T_c = 8.1 + 1.71 = 9.81 \text{ min.}$$

$$I_{50} = (7.44)(2.5)(9.81)^{-0.645} = 4.26 \text{ in/HR}$$

$$Q_{50} = C A I_{50} = (0.70)(0.68)(4.26) = 2.1 \text{ CFS}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = 4.0 \text{ FPS}$

$$T_f = \frac{665 - 100}{4 \times 60} = 2.35 \text{ min.}$$

$$T_c = 8.1 + 2.35 = 10.45 \text{ min.}$$

$$I_2 = (7.44)(1.1)(10.45)^{-0.645} = 1.80 \text{ in/HR}$$

$$I_{50} = (7.44)(2.5)(10.45)^{-0.645} = 4.09 \text{ in/HR}$$

$$I_{100} = (7.44)(2.5)(10.45)^{-0.645} = 4.42 \text{ in/HR}$$

$$Q_2 = (0.70)(0.68)(1.80) = 0.9 \text{ CFS}$$

$$Q_{50} = (0.70)(0.68)(4.09) = 2.0 \text{ CFS}$$

$$Q_{100} = (0.70)(0.68)(4.42) = 2.1 \text{ CFS}$$

BASIN B1

$$A = 0.18 \text{ AC}$$

SOIL TYPE D'

$$C = 0.9(0.9) + 0.46(1-0.9) = \underline{0.86}$$

(90% IMPERV.; 10% 2Dw/AC)

$$L = 240'$$

$$S = \frac{606 - 594}{240'} = 5.0\%$$

$$T_i = 7.4 \text{ min. } (L_m = 100')$$

Assume $V_{50} = 4.0 \text{ FPS}$

$$T_f = \frac{240 - 100}{4.60} = 0.58 \text{ min.}$$

$$T_c = 7.4 + 0.58 = 7.98 \text{ min}$$

$$I_{50} = (7.44)(2.5) 7.98^{-0.645} = 4.87 \text{ in/HR}$$

$$Q_{50} = CAI_{50} = 0.86(0.18)(4.87) = 0.8 \text{ cfs}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = 4.5 \text{ FPS}$

$$T_f = \frac{240 - 100}{4.5 \cdot 60} = 0.52 \text{ min.}$$

$$T_c = 7.4 + 0.52 = 7.92 \text{ min.}$$

$$I_2 = (7.44)(1.1) 7.92^{-0.645} = \underline{2.15 \text{ in/HR}}$$

$$I_{50} = (7.44)(2.5) 7.92^{-0.645} = \underline{4.90 \text{ in/HR}}$$

$$I_{100} = (7.44)(2) 7.92^{-0.645} = \underline{5.29 \text{ in/HR}}$$

$$\underline{Q_2 = (0.86)(0.18)(2.15) = 0.3 \text{ cfs}}$$

$$\underline{Q_{50} = (0.86)(0.18)(4.90) = 0.8 \text{ cfs}}$$

$$\underline{Q_{100} = (0.86)(0.18)(5.29) = 0.9 \text{ cfs}}$$

BASIN B2

$$A = 1.81 \text{ ac}$$

SOIL TYPE 'D'

$$C = 0.9(0.45) + 0.46(0.55) = \underline{0.66}$$

(45% IMPERV.; 55% ZDV/AC)

$$L = 675'$$

$$S = \frac{625 - 590}{675} = \underline{5.2\%}$$

$$T_i = 7.4 \text{ min. } (L_m = 100')$$

ASSUME $V_{50} = 5.0 \text{ FPS}$

$$T_f = \frac{675 - 100}{5.60} = 1.92 \text{ min.}$$

$$T_c = 7.4 + 1.92 = 9.32 \text{ min.}$$

$$I_{50} = (7.44)(2.5) 9.32^{-0.645} = 4.41 \text{ in/hr}$$

$$Q_{50} = CAI_{50} = (0.66)(1.81)(4.41) = 5.3 \text{ cfs}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = \underline{5.3 \text{ FPS}}$

$$T_f = \frac{675 - 100}{5.3 \cdot 60} = \underline{1.81 \text{ min.}}$$

$$T_c = 7.4 + 1.81 = \underline{9.21 \text{ min.}}$$

$$\underline{I_2} = (7.44)(1.1) 9.21^{-0.645} = \underline{1.95 \text{ in/hr}}$$

$$\underline{I_{50}} = (7.44)(2.5) 9.21^{-0.645} = \underline{4.44 \text{ in/hr}}$$

$$\underline{I_{100}} = (7.44)(2.7) 9.21^{-0.645} = \underline{4.80 \text{ in/hr}}$$

$$\underline{Q_2} = (0.66)(1.81)(1.95) = \underline{2.3 \text{ cfs}}$$

$$\underline{Q_{50}} = (0.66)(1.81)(4.44) = \underline{5.3 \text{ cfs}}$$

$$\underline{Q_{100}} = (0.66)(1.81)(4.80) = \underline{5.7 \text{ cfs}}$$

BASIN B3

$$A = 1.76 \text{ AC}$$

SOC TYPE D'

$$C = 0.9(0.1) + 0.46(0.9) = \underline{0.50}$$

(10% IMPER.; 90% 2DU/AC)

$$L = 525'$$

$$S = \frac{622 - 590}{525} = 6.1\%$$

$$T_i = 7.0 \text{ MIN. } (L_M = 100')$$

ASSUME $V_{50} = 5.0 \text{ FPS}$

$$T_f = \frac{525 - 100}{5.0 \cdot 60} = 1.42 \text{ MIN.}$$

$$T_c = 7.0 + 1.42 = 8.42 \text{ MIN.}$$

$$I_{50} = (7.44)(2.5)8.42^{-0.45} = 4.71 \text{ in/HR}$$

$$Q_{50} = CA I_{50} = (0.50)(1.76)(4.71) = 4.1 \text{ CFS}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = \underline{5.5 \text{ FPS}}$

$$T_f = \frac{525 - 100}{5.5 \cdot 60} = 1.29 \text{ MIN.}$$

$$T_c = 7.0 + 1.29 = \underline{8.29 \text{ MIN.}}$$

$$I_2 = (7.44)(1.1)8.29^{-0.45} = \underline{2.09 \text{ in/HR}}$$

$$I_{50} = (7.44)(2.5)8.29^{-0.45} = \underline{4.75 \text{ in/HR}}$$

$$I_{100} = (7.44)(2.7)8.29^{-0.45} = \underline{5.13 \text{ in/HR}}$$

$$\underline{Q_2 = (0.50)(1.76)(2.09) = 1.8 \text{ CFS}}$$

$$\underline{Q_{50} = (0.50)(1.76)(4.75) = 4.2 \text{ CFS}}$$

$$\underline{Q_{100} = (0.50)(1.76)(5.13) = 4.5 \text{ CFS}}$$

BASIN B41

$$A = 1.60 \text{ ac}$$

SOC TYPE 'D'

$$C = 0.9(0.20) + 0.46(0.80) = \underline{0.55}$$

(20% IMPERV.; 80% DUL/ac)

$$L = 535'$$

$$S = \frac{600 - 580}{535} = 3.7\%$$

$$T_i = 8.2 \text{ min. } (L_i = 100')$$

ASSUME $V_{50} = 4.5 \text{ fpm}$

$$T_f = \frac{535 - 100}{4.5 \cdot 60} = 1.61 \text{ min.}$$

$$T_c = 8.2 + 1.61 = 9.81 \text{ min.}$$

$$I_{50} = (7.44)(2.5) 9.81^{-0.45} = 4.26 \text{ in/hr}$$

$$Q_{50} = CAI_{50} = (0.55)(1.60)(4.26) = 3.7 \text{ cfs}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = 4.2 \text{ fpm}$

$$T_f = \frac{535 - 100}{4.2 \cdot 60} = 1.73 \text{ min.}$$

$$T_c = 8.2 + 1.73 = \underline{9.93 \text{ min.}}$$

$$I_2 = (7.44)(1.1) 9.93^{-0.45} = \underline{1.86 \text{ in/hr}}$$

$$I_{50} = (7.44)(2.5) 9.93^{-0.45} = \underline{4.23 \text{ in/hr}}$$

$$I_{100} = (7.44)(2.7) 9.93^{-0.45} = \underline{4.57 \text{ in/hr}}$$

$$\underline{Q_2 = (0.55)(1.60)(1.86) = 1.6 \text{ cfs}}$$

$$\underline{Q_{50} = (0.55)(1.60)(4.23) = 3.7 \text{ cfs}}$$

$$\underline{Q_{100} = (0.55)(1.60)(4.57) = 4.0 \text{ cfs}}$$

BASIN B5

$$\underline{\text{AREA} = 0.85 \text{ AC}}$$

SOIL TYPE = D'

C = 0.35 (VEGETATION ONLY)

L = 595'

$$\underline{S = \frac{594 - 562}{595} = 5.4\%}$$

$$T_c = T_i + T_f$$

$$T_i = \frac{8.7 \text{ min.}}{385} (\text{TABLE 3-2, NATURAL}) L_n = 100'$$

$$T_f = \frac{(11.9 L^3)}{\Delta E} \quad \begin{matrix} L = 495' \\ \Delta E = 32 \end{matrix} = 0.094 \text{ min.}$$

$$T_f = \left[\frac{11.9 (0.094)^3}{32} \right]^{385} \times 60 = 2.67 \text{ min.}$$

$$T_c = 8.7 + 2.67 = 11.37 \text{ min.}$$

$$I_2 = (7.44)(1.1) 11.37^{-0.645} = \underline{1.7 \text{ in/hr}}$$

$$I_{50} = (7.44)(2.5) 11.37^{-0.645} = \underline{3.9 \text{ in/hr}}$$

$$I_{100} = (7.44)(2.7) 11.37^{-0.645} = \underline{4.2 \text{ in/hr}}$$

$$Q_2 = CAI_2 = (0.35)(0.85)(1.70) = \underline{0.5 \text{ cfs}}$$

$$Q_{50} = CAI_{50} = (0.35)(0.85)(3.90) = \underline{1.2 \text{ cfs}}$$

$$Q_{100} = CAI_{100} = (0.35)(0.85)(4.20) = \underline{1.3 \text{ cfs}}$$

BASIN B6

$$A = 1.71 \text{ AC} \quad \text{SOIL TYPE D'}$$

$$C = 0.9(0.15) + 0.46(0.85) = \underline{0.53}$$

(15% IMPERV.; 85% 2 DU/AC)

$$L = 400'$$

$$S = 1.0\%$$

$$T_i = 10.5 \text{ min. } (L_m = 20')$$

ASSUME $V_{50} = 2.5 \text{ FPS}$

$$\bar{T}_r = \frac{400 - 20}{2.5 \cdot 60} = 2.2 \text{ min.}$$

$$T_c = 10.5 + 2.2 = 12.7 \text{ min.}$$

$$I_{50} = (2.44)(2.5) 12.7^{0.645} = \underline{3.61 \text{ in/hr}}$$

$$Q_{50} = C A I_{50} = (0.53)(1.71)(3.61) = \underline{3.3 \text{ cfs}}$$

FROM FIGURE 3.6 $\rightarrow V_{50} = 2.5 \text{ FPS}$

$$T_c = 12.70 \text{ min.}$$

$$I_2 = (2.44)(1.1) 12.7^{0.645} = \underline{1.59 \text{ in/hr}}$$

$$I_{50} = (2.44)(2.5) 12.7^{0.645} = \underline{3.61 \text{ in/hr}}$$

$$I_{100} = (2.44)(2.7) 12.7^{0.645} = \underline{3.90 \text{ in/hr}}$$

$$Q_2 = (0.53)(1.71)(1.59) = \underline{1.4 \text{ cfs}}$$

$$Q_{50} = (0.53)(1.71)(3.61) = \underline{3.3 \text{ cfs}}$$

$$Q_{100} = (0.53)(1.71)(3.90) = \underline{3.5 \text{ cfs}}$$

BASIN B7

$$\text{AREA} = 2.09 \text{ AC}$$

SOIL TYPE = 'D'

$$C = 0.35(0.75) + 0.46(0.25) = \underline{0.38}$$

(75% NATURAL, 25% 2 OU/AC)

$$L = 735'$$

$$S = \frac{568 - 536}{735} = \underline{4.4\%}$$

$$T_C = T_i + T_f$$

$$T_i = 9.2 \text{ min. (TABLE 3-2, NATURAL)} L_m = 100'$$

$$T_f = \left[\frac{11.9 L^3}{\Delta E} \right]^{.385} \quad L = 735' - 100' = 635' = 0.12 \text{ mi.} \\ \Delta E = 32'$$

$$T_f = \left[\frac{(11.9)(0.12)^3}{32} \right]^{.385} \times 60 = \underline{3.54 \text{ min.}}$$

$$T_C = T_i + T_f = 9.2 + 3.54 = \underline{12.74 \text{ min.}}$$

$$I_2 = (2.44)(1.1) 12.74^{-0.645} = \underline{1.6 \text{ in./hr}}$$

$$I_{50} = (2.44)(2.5) 12.74^{-0.645} = \underline{3.6 \text{ in./hr}}$$

$$I_{100} = (2.44)(2.7) 12.74^{-0.645} = \underline{3.9 \text{ in./hr}}$$

$$Q_2 = CAI_2 = (0.38)(2.09)(1.6) = \underline{1.3 \text{ cfs}}$$

$$Q_{50} = CAI_{50} = (0.38)(2.09)(3.6) = \underline{2.9 \text{ cfs}}$$

$$Q_{100} = CAI_{100} = (0.38)(2.09)(3.9) = \underline{3.1 \text{ cfs}}$$

BASIN C1

$$A = 2.84 \text{ AC}$$

SOIL TYPE 'D'

$$C = 0.9(0.2) + 0.46(0.8) = \underline{0.55}$$

(20% IMPERV.; 80% ZDV/AC)

$$L = 820'$$

$$S = 2.5\%$$

$$T_i = 9.0 \text{ min. } (L = 92.5')$$

Assume $V_{50} = 4.0 \text{ FPS}$

$$T_f = \frac{820 - 92.5}{4.0 \times 60} = 3.03 \text{ min.}$$

$$T_c = 9.0 + 3.03 = 12.03 \text{ min.}$$

$$I_{50} = (7.44)(2.5)12.03^{-0.645} = 3.74 \text{ in/HR}$$

$$Q_{50} = CAI_{50} = (0.55)(2.84)(3.74) = 5.8 \text{ CFS}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = 4.0 \text{ F/S}$

$$\underline{T_c = 12.03 \text{ min.}}$$

$$\underline{I_2 = (7.44)(1.1)12.03^{-0.645} = 1.65 \text{ in/HR}}$$

$$\underline{I_{30} = (7.44)(2.5)12.03^{-0.645} = 3.74 \text{ in/HR}}$$

$$\underline{I_{100} = (7.44)(2.7)12.03^{-0.645} = 4.04 \text{ in/HR}}$$

$$\underline{Q_2 = (0.55)(2.84)(1.65) = 2.6 \text{ CFS}}$$

$$\underline{Q_{50} = (0.55)(2.84)(3.74) = 5.8 \text{ CFS}}$$

$$\underline{Q_{100} = (0.55)(2.84)(4.04) = 6.3 \text{ CFS}}$$

BASIN C2

$$A = 1.41 \text{ ac}$$

SOIL TYPE 'D'

$$C = 0.9(0.25) + 0.46(0.75) = \underline{0.57}$$

(25% IMPERV.; 75% DOW/ac)

$$L = 655'$$

$$S = 2.5\%$$

$$T_i = 9.0 \text{ min. } (L_M = 92.5')$$

ASSUME $V_{50} = 4.0 \text{ FPS}$

$$T_f = \frac{655 - 92.5}{4.60} = 2.34 \text{ min.}$$

$$T_c = 9.0 + 2.34 = 11.34 \text{ min.}$$

$$I_{50} = (7.44)(2.5) 11.34^{-0.645} = 3.88 \text{ in/HR}$$

$$Q_{50} = CA I_{50} = (0.57)(1.41)(3.88) = 3.1 \text{ CFS}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = \underline{3.7 \text{ FPS}}$

$$T_f = \frac{655 - 92.5}{3.7 \cdot 60} = 2.53 \text{ min.}$$

$$T_c = 9.0 + 2.53 = \underline{11.53 \text{ min.}}$$

$$I_2 = (7.44)(1.1) 11.53^{-0.645} = \underline{1.69 \text{ in/HR}}$$

$$I_{50} = (7.44)(2.5) 11.53^{-0.645} = \underline{3.84 \text{ in/HR}}$$

$$I_{100} = (7.44)(2.7) 11.53^{-0.645} = \underline{4.15 \text{ in/HR}}$$

$$Q_2 = (0.57)(1.41)(1.69) = \underline{1.4 \text{ CFS}}$$

$$Q_{50} = (0.57)(1.41)(3.84) = \underline{3.1 \text{ CFS}}$$

$$Q_{100} = (0.57)(1.41)(4.15) = \underline{3.3 \text{ CFS}}$$

BASIN C3

$$A = 1.28 \text{ AC}$$

SOIL TYPE 'D'

$$C = 0.9(0.20) + 0.46(0.80) = \underline{0.55}$$

(20% IMPERV.; 80% ZONE/AC)

$$L = 550'$$

$$S = 2.5\%$$

$$T_i = 9.0 \text{ min. } (L_m = 92.5')$$

ASSUME $V_{50} = 3.7 \text{ FPS}$

$$T_f = \frac{550 - 92.5}{3.7 \cdot 60} = 2.06 \text{ min.}$$

$$T_c = 9.0 + 2.06 = 11.06 \text{ min.}$$

$$I_{50} = (7.44)(2.5) 11.06^{-0.645} = \underline{3.95 \text{ in/HR}}$$

$$Q_{50} = CA I_{50} = (0.55)(1.28)(3.95) = 2.8 \text{ cfs}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = 3.6 \text{ FPS}$

$$T_f = \frac{550 - 92.5}{3.6 \cdot 60} = \underline{2.12 \text{ min.}}$$

$$T_c = 9.0 + 2.12 = \underline{11.12 \text{ min.}}$$

$$I_2 = (7.44)(1.1) 11.12^{-0.645} = \underline{1.73 \text{ in/HR}}$$

$$I_{50} = (7.44)(2.5) 11.12^{-0.645} = \underline{3.93 \text{ in/HR}}$$

$$I_{100} = (7.44)(2.7) 11.12^{-0.645} = \underline{4.25 \text{ in/HR}}$$

$$Q_2 = (0.55)(1.28)(1.73) = \underline{1.2 \text{ cfs}}$$

$$Q_{50} = (0.55)(1.28)(3.93) = \underline{2.8 \text{ cfs}}$$

$$Q_{100} = (0.55)(1.28)(4.25) = \underline{3.0 \text{ cfs}}$$

BASIN C4

$$A = 1.02 \text{ ac}$$

Soil type 'D'

$$C = 0.9(0.13) + 0.46(0.87) = 0.52$$

(13% IMPERV.; 87% 2 DRY/HR)

$$L = 385$$

$$S = 2.5\%$$

$$T_i = 9.0 \text{ min. } (L_m = 92.5')$$

Assume $V_{50} = 4.0 \text{ fpm}$

$$T_f = \frac{385 - 92.5}{4.60} = 1.22 \text{ min.}$$

$$T_c = 9.0 + 1.22 = 10.22 \text{ min.}$$

$$I_{50} = (7.44)(2.5)^{0.645} = 4.15 \text{ in/HR}$$

$$Q_{50} = CA I_{50} = (0.52)(1.02)(4.15) = 2.2 \text{ CFS}$$

FROM FIGURE 3-6 $\rightarrow V_{50} = 3.4 \text{ CFS}$

$$T_f = \frac{385 - 92.5}{3.4 \cdot 60} = 1.43 \text{ min.}$$

$$T_c = 9.0 + 1.43 = 10.43 \text{ min.}$$

$$I_2 = (7.44)(1.1)^{0.645} = 1.80 \text{ in/HR}$$

$$I_{50} = (7.44)(2.5)^{0.645} = 4.10 \text{ in/HR}$$

$$I_{100} = (7.44)(2.7)^{0.645} = 4.40 \text{ in/HR}$$

$$Q_2 = (0.52)(1.02)(1.80) = 1.0 \text{ CFS}$$

$$Q_{50} = (0.52)(1.02)(4.10) = 2.2 \text{ CFS}$$

$$Q_{100} = (0.52)(1.02)(4.40) = 2.3 \text{ CFS}$$

BASIN CS

$$A = 1.44 \text{ ac}$$

SOIL TYPE D'

$$C = 0.9(15) + 0.46(85) = \underline{0.53}$$

(15% IMPERV.; 85% ZDG/ac)

$$L = 470'$$

$$S = 2.5\%$$

$$T_f = \underline{9.0 \text{ min.}} \quad (L_m = 92.5')$$

ASSUME $V_{50} = 3.6 \text{ FPS}$

$$T_f = \frac{470 - 92.5}{3.6 \cdot 60} = 1.75 \text{ min.}$$

$$T_c = 9.0 + 1.75 = 10.75 \text{ min.}$$

$$I_{50} = (1.44)(2.5) 10.75^{-0.645} = 4.02 \text{ in/hr}$$

$$Q_{50} = CAI_{50} = (0.53)(1.44)(4.02) = 3.1 \text{ cfs}$$

FROM FIG. 3-6 $\rightarrow V_{50} = \underline{3.6 \text{ FPS}}$

$$\underline{T_c = 10.75 \text{ min.}}$$

$$I_2 = (1.44)(1.1) 10.75^{-0.645} = \underline{1.77 \text{ in/hr}}$$

$$I_{50} = (1.44)(2.5) 10.75^{-0.645} = \underline{4.02 \text{ in/hr}}$$

$$I_{100} = (1.44)(2.7) 10.75^{-0.645} = \underline{4.34 \text{ in/hr}}$$

$$Q_2 = (0.53)(1.44)(1.77) = \underline{1.4 \text{ cfs}}$$

$$Q_{50} = (0.53)(1.44)(4.02) = \underline{3.1 \text{ cfs}}$$

$$Q_{100} = (0.53)(1.44)(4.34) = \underline{3.3 \text{ cfs}}$$

BASIN C6

$$\text{AREA} = \underline{0.78 \text{ AC}}$$

SOIL TYPE = D'

$$C = 0.9(0.40) + 0.46(1-0.40) = \underline{0.64}$$

(40% Asphalt Road, 60% 2 Pct/AC)

$$L = \underline{1,020'}$$

$$S = \frac{580 - 543}{1,020} = \underline{3.6\%}$$

$$T_C = T_i + T_f$$

$$T_i = \underline{8.5 \text{ min. (TABLE 3-2, 200/AC) (m = 100')}}$$

$$T_f = \left(\frac{11.9 L^3}{\Delta E} \right)^{.385} \quad L = 1,020 - 100 = 920' = 0.17 \text{ mi.} \\ \Delta E = 32$$

$$T_f = \left[\frac{11.9 (17)^3}{32} \right]^{.385} \times 60 = \underline{5.01 \text{ min.}}$$

$$T_C = \underline{8.5 + 5.01 = 13.51 \text{ min.}}$$

$$I_2 = (0.44)(1.1)13.51^{-0.645} = \underline{1.5 \text{ in/hr}}$$

$$I_{50} = (0.44)(2.5)13.51^{-0.645} = \underline{3.5 \text{ in/hr}}$$

$$I_{100} = (0.44)(2.7)13.51^{-0.645} = \underline{3.7 \text{ in/hr}}$$

$$Q_2 = CAI_2 = (0.64)(.78)(1.5) = \underline{0.7 \text{ cfs}}$$

$$Q_{50} = CAI_{50} = (0.64)(.78)(3.5) = \underline{1.7 \text{ cfs}}$$

$$Q_{100} = CAI_{100} = (0.64)(.78)(3.7) = \underline{1.8 \text{ cfs}}$$

APPENDIX 3

HYDRAULIC CALCULATIONS – EXISTING PLUS PROPOSED CONDITION

HYDRAULIC CALCULATIONS

EXISTING PLUS PROPOSED CONDITION

BASIN A1

$$Q_{100} = 2.2 \text{ CFS}$$

→ PROPOSED CONVEYANCE = GUTTER FLOW

STREET SLOPE = 8.0%

FROM FIG. 3-6 → $d = 0.22'$ → OKAY

→ INLET DESIGN - INLET ON GRADE

$$\begin{aligned} L_{\text{req.}} &= \frac{Q_{100}}{\sqrt{a+y}} \quad a = 0.17' \\ &= \frac{2.2}{\sqrt{(.17+.22)}} \quad y = 0.22' \end{aligned}$$

$$L_{\text{req.}} = 12.9' \sim 13'$$

∴ USE 14' TYPE B-i CURB INLET

→ PIPE DESIGN - TR4. 18" RCP @ 1.0% MIN.

$$Q_{\text{desp}} = 1055.01 = 10.5 \text{ CFS}$$

$$10.5 > 2.2$$

∴ 18" RCP @ 1.0% MIN. SLOPE IS OKAY

BASIN A2

$$Q_{100} = 3.5 \text{ cfs}$$

→ GUTTER FLOW

$$\text{STREET SLOPE} = 5.8\%$$

FROM FIG. 3-6 → $d = 0.27'$ → OKAY

→ INLET DESIGN - INLET ON GRADE

$$L_{\text{REQ.}} = \frac{Q_{100}}{0.7(a+y)^{3/2}} \quad a = 0.17', \\ y = 0.27' \\ = \frac{3.5}{0.7(1.17+0.27)^{3/2}}$$

$$L_{\text{REQ.}} = 17.1' \sim 18'$$

∴ USE 18' TYPE B-1 CURB INLET

BASIN A3

$$Q_{100} = 4.4 \text{ cfs}$$

→ GUTTER FLOW

$$\text{STREET SLOPE} = 5.8\%$$

FROM FIG. 3-6 → $d = 0.28'$ → OKAY

→ INLET DESIGN - INLET ON GRADE

$$L_{\text{REQ.}} = \frac{Q_{100}}{.7(a+y)^{3/2}} \quad a = 0.17' \\ y = 0.28'$$

$$L_{\text{REQ.}} = \frac{4.4}{.7(.17+.28)^{3/2}}$$

$$L_{\text{REQ.}} = 20.8' \sim 21'$$

TOO LARGE (20' MAX.)

ALLOW 10% OF FLOW TO BYPASS

$$0.9(Q_{100}) = 0.9(4.4) = 4.0 \text{ cfs}$$

$$L_{\text{REQ.}} = \frac{4.0}{.7(.17+.28)^{3/2}}$$

$$L_{\text{REQ.}} = 18.9 \sim 19'$$

∴ USE 20' TYPE 'B-1' CURB INLET

→ PIPE DESIGN - TRY 18" RCPE 1.0% M.L.S.

$$Q_{\text{CAP}} = 105 \sqrt{.01} = 10.5 \text{ cfs} > 4.0 \text{ cfs}$$

∴ USE 18" RCPE 1.0% M.L.S. SCOPE

BASIN A4

$$Q_{100} = 2.8 \text{ cfs}$$

→ GUTTER FLOW

$$\text{STREET SLOPE} = 5.8\%$$

FROM FIG. 3-6 → $d = 0.25'$ → OKAY

→ INLET DESIGN - INLET ON GRADE

$$\begin{aligned} L_{\text{REQ.}} &= \frac{Q_{100}}{\gamma(a+y)^{3/2}} & a = 0.17 \\ &= \frac{2.8}{\gamma(0.17+0.25)^{3/2}} & y = 0.25' \end{aligned}$$

$$L_{\text{REQ.}} = 14.7' \sim 15'$$

∴ USE 16' TYPE B-1 CURB OUTLET

→ PIPE DESIGN - IR 4 18" RCP @ 1.0% MIN.

$$Q_{\text{CAP}} = 105 \sqrt{0.01} = 10.5 \text{ cfs}$$

$$10.5 > 2.8$$

∴ USE 18" RCP @ 1.0% SLOPE MIN.

BASIN A5

$$Q_{100} = 8.2 \text{ CFS} + 0.4 \text{ CFS} (\text{BYPASS FROM A3})$$

$$\underline{Q_{100} = 8.6 \text{ CFS}}$$

→ GUTTER FLOW ($Q_{\text{MAX}} = \frac{Q_{100}}{2} = \frac{8.6}{2} = 4.3 \text{ CFS}$
IN EACH GTR.)

STREET SLOPE = 1.0%

FROM FIG. 3-6 → $d = 0.37'$ → OKAY

→ INLET DESIGN - INLET IN SAG.

$$Q_{100} = C_w L_w d^{3/2}$$

$$C_w = 3.0 \\ d = 0.50 \text{ (MAX.)}$$

$$8.6 = 3.0 L_w (0.5)^{3/2}$$

$$L_w = 8.1' \sim 9'$$

∴ USE 10' TYP B-2 CURB INLET

BASIN A6

$$Q_{100} = 2.1 \text{ cfs}$$

→ GUTTER FLOW

$$\text{STREET SLOPE} = 3.8\%$$

FROM FIGURE 3-6 → $d = 0.24'$ → OKAY

BASIN A6 + EX-3

$$Q_{100} = 2.1 + 23.8 = \underline{\underline{25.9 \text{ cfs}}}$$

→ CURB INLET - IN SAG CONDITION

$$Q_{100} = C_w L_w d^{3/2}$$

$$25.9 = (3.0) L_w (0.6)^{3/2}$$

$$L_w = 18.5' \sim 19'$$

$$\begin{aligned} C_w &= 3.0 \\ d &= 0.6' (\theta \text{ "curb}) \end{aligned}$$

∴ USE 20' TYPE B-2 CURB INLET

→ Pipe Design - TR4 24" RCP @ 1.5%

$$Q_{CAP} = 226 \sqrt{0.15} = 27.7 \text{ cfs}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{25.9}{27.7} = 0.94$$

$$d/D = 0.77$$

$$\frac{V_{100}}{V_{CAP}} = 1.14$$

$$V_{CAP} = \frac{Q_{CAP}}{A} = \frac{27.7}{3.14} = 8.8 \text{ f/s}$$

$$V_{100} = 1.14(8.8) = \underline{\underline{9.7 \text{ f/s}}}$$

USE RIP RAP TO DISSIPATE VELOCITY

(SIZE DURING FINAL ENGINEERING)

BASIN B1

$$Q_{100} = 0.8 \text{ cfs}$$

→ GUTTER FLOW

STREET SLOPE = 5.0%

FROM FIG. 3-6 → d = 0.18' → OKAY

BASIN B2

$$Q_{100} = 5.7 \text{ cfs}$$

→ GUTTER FLOW ($Q_{MAX} = Q_{100} = \frac{5.7}{2} = 2.9 \text{ cfs IN EACH GTR}$)

$$\text{STREET SLOPE} = 1.0\% \text{ (MIN.)}$$

$$\text{FROM FIG. 3-6} \rightarrow d = 0.32' \rightarrow \underline{\text{OKAY}}$$

→ INLET DESIGN — CURB INLET IN SAG

$$Q_{100} = C_w L_w d^{3/2}$$

$$C_w = 3.0 \\ d = 0.5 \text{ MAX}$$

$$5.7 = 3.0 L_w (0.5)^{3/2}$$

$$L_w = 5.37' \sim 6'$$

∴ USE 7' TYPE 'B-2' CURB INLET

→ PIPE DESIGN — TRY 18" RCP @ 1.0% MIN.

$$Q_{100} = 105 \sqrt{0.1} = 10.5 \text{ cfs}$$

$$10.5 > 5.7$$

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN B3

$$Q_{100} = 4.5 \text{ cfs}$$

→ GUTTER FLOW

$$\text{STREET SLOPE} = 1.0\%$$

FROM FIG. 3-6 → $d = 0.38'$ → OKAY

→ INLET DESIGN - INLET ON GRADE

$$L_{\text{REQ}} = \frac{Q_{100}}{\pi(a+y)^{3/2}} \quad a = 0.17' \\ y = 0.38'$$

$$L_{\text{REQ.}} = \frac{4.5}{\pi(0.17+0.38)^{3/2}}$$

$$L_{\text{REQ.}} = 15.7' \sim 16'$$

∴ USE 17' TYPE 'B-1' CURB INLET

BASIN B4

$$Q_{100} = 4.0 \text{ cfs}$$

GUTTER FLOW

STREET SLOPE = 5.6% (MIN.)

FROM FIG. 3-6 $\rightarrow d = 0.28' \rightarrow \underline{\text{OKAY}}$

INLET DESIGN - CURB INLET ON GRADE

$$L_{\text{REQ.}} = \frac{Q_{100}}{\pi(a+y)^{3/2}} \quad \begin{array}{l} a=0.17' \\ y=0.28' \end{array}$$

$$L_{\text{REQ.}} = \frac{4.0}{\pi(0.17+0.28)^{3/2}}$$

$$L_{\text{REQ.}} = 18.9' \sim 19.0'$$

$\therefore \text{USE } 20' \text{ TYPE 'B-1' CURB INLET}$

BASIN BS

$$Q_{100} = 1.3 \text{ cfs}$$

→ BROW DITCH FOR EASTERLY PORTION

TRY TYPE 'B' DITCH PER D-75 @ 1.0%

$Q_{cap} = 11.3 \text{ cfs}$ (SEE BASIN AG, PAGE 6)

$$11.3 > 1.3$$

∴ USE TYPE 'B' BROW DITCH PER D-75 @ 1.0%
MIN. SCORE.

BASIN B6

$$Q_{100} = 3.5 \text{ cfs}$$

→ GUTTER FLOW

$$\text{STREET SLOPE} = 1.0\%$$

FROM FIG. 3-6 → $d = 0.34'$ → OKAY

→ INLET DESIGN - INLET IN SAG.

$$Q_{100} = C_w L_w d^{3/2}$$

$$3.5 = 3.0 L_w (0.5)^{3/2}$$

$$L_w = 3.3' - 4'$$

$$C_w = 3.0$$

$$d = 0.5 \text{ MAX.}$$

∴ USE 5' TYPE B-2 CURB INLET

→ PIPE DESIGN - TR 18" RCP @ 1.0%

$$Q_{CAP} = 105 \sqrt{0.1} = 10.5 \text{ cfs}$$

$$10.5 > 3.5$$

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN C1

$$Q_{100} = 6.3 \text{ cfs}$$

GUTTER FLOW

$$\text{STREET SLOPE} = 2.5\%$$

FROM FIG. 3-6 $\rightarrow d = 0.36' \rightarrow \underline{\text{OKAY}}$

INLET DESIGN - INLET ON GRADE

CAPTURE 85% OF Q_{100} & ALLOW 15% TO BYPASS

$$(85)(6.3) = 5.4 \text{ cfs}$$

$$L_{\text{req.}} = \frac{Q_{100}}{.7(a+y)^{1/2}}$$

$$a = 0.17' \\ y = 0.36'$$

$$L_{\text{req.}} = \frac{5.4}{.7(0.17+0.36)^{1/2}}$$

$$L_{\text{req.}} = 19.9' \sim 20'$$

$\therefore \text{USE } 21' \text{ TYPE B-1 CURB INLET}$

PIPE DESIGN - T14 18" RCPC 1.0%

$$Q_{\text{cap}} = 105 \sqrt{1.01} = 10.5 \text{ cfs}$$

$$10.5 > 5.4$$

$\therefore \text{USE } 18" \text{ RCPC 1.0% MIN. SLOPE}$

BASIN C2

$$Q_{100} = 3.3 \text{ cfs}$$

→ GUTTER FLOW

$$\text{STREET SLOPE} = 2.5\%$$

$$\text{FROM FIG. 3-6} \rightarrow d = 0.29' \rightarrow \underline{\text{OKAY}}$$

→ INLET DESIGN - INLET ON GRADE

$$L_{\text{REQ.}} = \frac{Q_{100}}{.7(a+y)^{3/2}} \quad a = 0.17' \\ y = 0.29'$$

$$L_{\text{REQ.}} = \frac{3.3}{.7(0.17+0.29)^{3/2}}$$

$$L_{\text{REQ.}} = 15.1' \sim 16'$$

∴ USE 17' TYPE B-1 CURB INLET

→ PIPE DESIGN - TR4 18" RCP @ 1.0%

$$Q_{\text{CAP}} = 105 \sqrt{.01} = 10.5 \text{ cfs}$$

$$10.5 > 3.3$$

∴ USE 18" RCP @ 1.0% UNI. SLOPE

BASIN C3

$$Q_{100} = 3.0 \text{ cfs}$$

→ GUTTER FLOW

$$\text{STREET SLOPE} = 2.5\%$$

$$\text{FROM FIG. 3-6} \rightarrow d = 0.28' \rightarrow \underline{\text{OKAY}}$$

→ INLET DESIGN - INLET ON GRADE

$$L_{\text{REQ.}} = \frac{Q_{100}}{7(a+y)^{3/2}} \quad a = 0.17' \\ y = 0.28'$$

$$L_{\text{REQ.}} = \frac{3.0}{7(0.17+0.28)^{3/2}}$$

$$L_{\text{REQ.}} = 14.2' \sim 15'$$

∴ USE 15' TYPE B-1 CURB INLET

→ PIPE DESIGN - TRY 18" RCP E 1.0%

$$Q_{\text{CAP}} = 105 \sqrt{0.1} = 10.5 \text{ cfs}$$

$$10.5 > 3.0$$

∴ USE 18" RCP E 1.0% MIN. SLOPE

BASIN C4

$$Q_{100} = 2.3 \text{ cfs}$$

→ GUTTER FLOW

$$\text{STREET SLOPE} = 2.5\%$$

FROM FIG. 3-6 → $d = 0.27'$ → OKAY

→ INLET DESIGN - INLET ON GRADE

$$L_{\text{REQ.}} = \frac{0.09}{.7(a+y)^{3/2}} \quad d = 0.12' \\ y = 0.27'$$

$$L_{\text{REQ.}} = \frac{2.3}{.7(0.12+0.27)^{3/2}}$$

$$L_{\text{REQ.}} = 11.3 \sim 12'$$

∴ USE 13' TYPE B-1 CURB INLET

→ PIPE DESIGN - TRY 18" RCP @ 1.0%

$$Q_{\text{CAP}} = 105/.01 = 10.5 \text{ cfs}$$

$$10.5 > 2.3$$

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN C5

$$Q_{100} = 3.3 \text{ cfs}$$

→ OUTER FLOW

$$\text{STREET SCOPE} = 2.5\%$$

FROM FIG. 3-6 → $d = 0.29'$ → OK

→ INLET DESIGN - INLET ON GRADE

$$L_{\text{req.}} = \frac{Q_{100}}{\pi(a+y)^{3/2}} \quad a=0.17' \\ y=0.29'$$

$$L_{\text{req.}} = \frac{3.3}{\pi(0.17+0.29)^{3/2}}$$

$$L_{\text{req.}} = 15.1 \sim 16'$$

∴ USE 17' TYPE 'B-1' CURB INLET

→ PIPE DESIGN - 724 18" RCP @ 1.0%

$$Q_{\text{cap}} = 105 \sqrt{0.01} = 10.5 \text{ cfs}$$

$$10.5 > 3.3$$

∴ USE 18" RCP @ 1.0% MAX. SCOPE

APPENDIX 4

FLOW ROUTING CALCULATIONS – EXISTING CONDITION

FLOW ROUTING-EXISTING CONDITION

COMBINE BASINS EX1, EX2 + EX5

(Q_{3T₃}) EX1: T_C = 17.93 min.; I₁₀₀ = 3.1 IPA; Q₁₀₀ = 182.9 cfs

(Q_{2T₂}) EX2: T_C = 9.80 min.; I₁₀₀ = 4.6 IPA; Q₁₀₀ = 18.5 cfs

(Q_{1T₁}) EX5: T_C = 9.56 min.; I₁₀₀ = 4.7 IPA; Q₁₀₀ = 6.9 cfs

$$Q_{T_1} = 6.9 + \left(\frac{9.56}{9.80}\right) 18.5 + \left(\frac{9.56}{17.93}\right) 182.9 = 122.5 \text{ cfs}$$

$$Q_{T_2} = 18.5 + \left(\frac{4.6}{4.7}\right) 6.9 + \left(\frac{4.6}{12.93}\right) 182.9 = 125.2 \text{ cfs}$$

$$\underline{Q_{T_3} = 182.9 + \left(\frac{3.1}{4.7}\right) 6.9 + \left(\frac{3.1}{12.93}\right) 18.5 = 199.9 \text{ cfs}}$$

COMBINE BASINS EX3 + EX4

(Q_{1T₁}) EX3: T_C = 9.11 min.; I₁₀₀ = 4.8 IPA; Q₁₀₀ = 23.8 cfs

(Q_{2T₂}) EX4: T_C = 15.53 min.; I₁₀₀ = 3.4 IPA; Q₁₀₀ = 27.6 cfs

$$Q_{T_1} = 23.8 + \left(\frac{9.11}{15.53}\right) 27.6 = 40.0 \text{ cfs}$$

$$\underline{Q_{T_2} = 27.6 + \left(\frac{3.4}{4.8}\right) 23.8 = 44.5 \text{ cfs}}$$

COMBINE BASINS EX6, EX7 + EX8

Q_{T3} EX6: $T_c = 13.93 \text{ min.}; I_{100} = 3.7 \text{ in.}; Q_{100} = 84.2 \text{ cfs}$

Q_T EX7: $T_c = 10.76 \text{ min.}; I_{100} = 4.3 \text{ in.}; Q_{100} = 6.3 \text{ cfs}$

Q_{LTL} EX8: $T_c = 12.92 \text{ min.}; I_{100} = 3.9 \text{ in.}; Q_{100} = 12.2 \text{ cfs}$

$$Q_{T_1} = 6.3 \text{ cfs} + \left(\frac{10.76}{12.92} \right) 12.2 + \left(\frac{10.76}{13.93} \right) 84.2 = \underline{\underline{81.5 \text{ cfs}}}$$

$$Q_{T_2} = 12.2 + \left(\frac{3.9}{4.3} \right) 6.3 + \left(\frac{12.92}{13.93} \right) 84.2 = \underline{\underline{96.0 \text{ cfs}}}$$

$$\underline{Q_{T_3} = 84.2 + \left(\frac{3.7}{4.3} \right) 6.3 + \left(\frac{3.7}{3.9} \right) 12.2 = \underline{\underline{101.2 \text{ cfs}}}}$$

TOTAL EXISTING CONDITION Routed

$$100 \text{ YEAR FLOOD} = 199.9 + 44.5 + 101.2$$

$$= \underline{\underline{345.6 \text{ cfs}}}$$

APPENDIX 5

FLOW ROUTING CALCULATIONS – EXISTING PLUS PROPOSED CONDITION

FLOW ROUTING CALCULATIONS

BASIN A1

$$T_c = 8.65 \text{ min.}$$

TIME IN PIPE (18" RCP)

$$L = 232'$$

$$S = 1.0\%$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{2.2}{10.5} = 0.21 \rightarrow d/D = 0.32$$

$$\frac{V_{100}}{V_{CAP}} = 0.79 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{10.5}{1.77} = 5.93 \text{ FPS}$$

$$V_{100} = 0.79(5.93) = 4.68 \text{ FPS}$$

$$T_f = \frac{232}{4.68 \cdot 60} = 0.83 \text{ min.}$$

$$\underline{\text{NEW } T_c @ SDCO} = 8.65 + 0.83 = \underline{9.48 \text{ min.}}$$

BASIN A2

$$T_c = 8.20 \text{ min.}$$

TIME IN PIPE (18" RCP)

$$\frac{L}{S} = \frac{171'}{5.8\%}$$

$$Q_{CAP} = 105 \sqrt{1.058} = 25.3 \text{ CFS}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{3.5}{25.3} = 0.14 \rightarrow d/b = 0.26$$

$$\frac{V_{100}}{V_{CAP}} = 0.72 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{25.3}{1.77} = 14.29$$

$$V_{100} = 0.72(14.29) = 10.29 \text{ FPS}$$

$$T_f = \frac{171'}{10.29 \cdot 60} = 0.28 \text{ min.}$$

$$\underline{\text{NEW } T_c \text{ @ SDCO}} = 8.20 + 0.28 = \underline{8.48 \text{ min.}}$$

COMBINE A2 + A3 (JUNCTION NODE 1)

$$A_2 : T_c = 8.48 \text{ min.}, Q_{100} = 3.5 \text{ CFS}$$

$$A_3 : T_c = 8.47 \text{ min.}, Q_{100} = 4.4 \text{ CFS}$$

$$\underline{Q_p = 3.5 + 4.4 = 7.9 \text{ CFS}} \quad (\text{SINCE } T_c \text{'S ARE EQUAL - ADD Q'S})$$

TIME IN PIPE (18" RCP)

$$\frac{L}{S} = \frac{31'}{5.8\%}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{7.7}{25.3} = 0.30 \rightarrow d/b = 0.38$$

$$\frac{V_{100}}{V_{CAP}} = 0.88 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{25.3}{1.77} = 14.29 \text{ FPS}$$

$$V_{100} = (0.88)(14.29) = \underline{12.58 \text{ f/s}}$$

$$T_f = \frac{31'}{12.58 \cdot 60} = \underline{0.04 \text{ min.}}$$

$$\underline{\text{NEW } T_c @ 50\%O} = 8.48 + 0.04 = \underline{8.52 \text{ min.}}$$

BASIN A4

$$T_c = 7.73 \text{ min.}$$

TIME on PIPE (18" RCP)

$$\begin{aligned} L &= 24' \\ S &= 10^{-3} \end{aligned}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{2.8}{10.5} = 0.27 \rightarrow d/I = 0.35$$

$$\frac{V_{100}}{V_{CAP}} = 0.85 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{10.5}{1.27} = 5.93 \text{ f/s}$$

$$V_{100} = (0.85)(5.93) = 5.04 \text{ f/s}$$

$$T_f = \frac{24'}{5.04 \cdot 60} = \underline{0.08 \text{ min.}}$$

$$\underline{\text{NEW } T_c @ 50\%O} = 7.73 + 0.08 = \underline{7.81 \text{ min.}}$$

COMBINE A1 + A2/A3 + A4 (FUNCTION NODE 2)

(Q₁/T₃) A1 : T_C = 9.48 ; I₁₀₀ = 4.71 m/HR; Q₁₀₀ = 2.2 CFS

(Q₂/T₂) A2/A3 : T_C = 8.52 ; I₁₀₀ = 5.04 m/HR; Q₁₀₀ = 7.9 CFS

(Q₁/T₁) A4 : T_C = 7.81 ; I₁₀₀ = 5.34 m/HR; Q₁₀₀ = 2.8 CFS

$$\underline{Q_T} = 2.8 + \left(\frac{7.81}{8.52} \right) 7.9 + \left(\frac{7.81}{9.48} \right) 2.2 = \underline{11.9 \text{ CFS}}$$

$$\underline{Q_T} = 7.9 + \left(\frac{5.04}{5.34} \right) 2.8 + \left(\frac{8.52}{9.48} \right) 2.2 = \underline{12.5 \text{ CFS}}$$

$$\underline{Q_T} = 2.2 + \left(\frac{4.71}{5.34} \right) 2.8 + \left(\frac{4.71}{5.04} \right) 7.9 = \underline{12.1 \text{ CFS}}$$

$$\therefore \underline{Q_T} = 12.5 \text{ CFS}, \underline{T_C} = 8.52 \text{ min.}$$

TIME IN PIPE (24" RCP)

$$\begin{cases} L = 233' \\ S = 1.0 \text{ \AA} \end{cases}$$

$$Q_{100} = 12.5 \text{ CFS}$$

$$Q_{CAP} = 226 \text{ ft.} = 22.6 \text{ CFS}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{12.5}{22.6} = 0.55 \rightarrow d/o = 0.54$$

$$\frac{V_{100}}{V_{CAP}} = 1.03 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{22.6}{3.14} = 7.19 \text{ FPS}$$

$$V_{100} = (1.03)(7.19) = \underline{2.41 \text{ FPS}}$$

$$T_f = \frac{233}{2.41 \cdot 60} = \underline{0.52 \text{ MIN.}}$$

$$\text{NEW } T_C @ \text{ SAG INLET} = 8.52 + 0.52 = \underline{9.04 \text{ MIN.}}$$

BASIN A5

$$T_C = 9.94 \text{ min.}$$

COMBINE BASINS A1-A4 + A5 (JUNC. NO. 3)

(Q_{1T}) A1/A4 : T_C = 9.04 min.; I₁₀₀ = 4.86 m/H₂O; Q₁₀₀ = 12.5 cfs

(Q_{2T}) A5 : T_C = 9.94 min.; I₁₀₀ = 4.57 m/H₂O; Q₁₀₀ = 8.2 cfs

$$\underline{Q_{T_1} = 12.5 + \left(\frac{9.04}{9.94}\right) 8.2 = 20.0 \text{ cfs}}$$

$$\underline{Q_{T_2} = 8.2 + \left(\frac{4.57}{4.86}\right) 12.5 = 20.0 \text{ cfs}}$$

$$\therefore \underline{Q_T = 20.0 \text{ cfs}} ; \underline{T_C = 9.04 \text{ min.}}$$

TIME IN PIPE (24"ACP)

$$\begin{aligned} L &= 239' \\ S &= 2.0\% \end{aligned}$$

$$Q_{100} = 20.0 \text{ cfs}$$

$$Q_{CAP} = 226 \sqrt{.02} = 32.0$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{20.0}{32.0} = .625 \rightarrow d/10 = 0.57$$

$$\frac{V_{100}}{V_{CAP}} = 1.05 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{32.0}{3.14} = 10.19 \text{ f/s}$$

$$V_{100} = 1.05(10.19) = \underline{10.70 \text{ f/s}}$$

$$T_f = \frac{239}{(10.7)(60)} = 0.37 \text{ min.}$$

$$\underline{\text{NEW } T_C @ \text{ BOTTOM OF SCOPE} = 9.04 + 0.37 = 9.41 \text{ min.}}$$

COMBINE BASINS A6 + EX3 (Junc. No. 4)

(Q_{2T2}) A6: T_C = 10.45 min.; I₁₀₀ = 4.42 in/hr; Q₁₀₀ = 2.1 cfs

(Q_{1T1}) EX3: T_C = 9.11 min.; I₁₀₀ = 4.80 in/hr; Q₁₀₀ = 23.8 cfs

$$\underline{Q_{T_1} = 23.8 + \left(\frac{9.11}{10.45}\right) 2.1 = 25.6 \text{ cfs}}$$

$$Q_{T_2} = 2.1 + \left(\frac{4.42}{4.80}\right) 23.8 = \underline{24.0 \text{ cfs}}$$

$$\therefore \underline{Q_T = 25.6 \text{ cfs}; T_C = 9.11 \text{ min.}}$$

TIME IN PIPE (24" RCP)

$$\begin{aligned} L &= 184' \\ S &= 1.54 \end{aligned}$$

$$Q_{100} = 25.6 \text{ cfs}$$

$$Q_{CAP} = 226\sqrt{0.015} = 27.7 \text{ cfs}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{25.6}{27.7} = 0.92 \rightarrow d/D = 0.75$$

$$\frac{V_{100}}{V_{CAP}} = 1.13 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{27.7}{3.14} = 8.82 \text{ f/s}$$

$$V_{100} = 1.13(8.82) = 9.97 \text{ f/s}$$

$$T_f = \frac{184}{9.97 \cdot 60} = \underline{0.31 \text{ min.}}$$

$$\underline{\text{NEW } T_C @ OUTLET = 9.11 + 0.31 = 9.42 \text{ min.}}$$

$$\underline{V_{100} = 9.97 \text{ f/s}}$$

COMBINE BASINS A1/A5 + A6/EX3 (JUNC. NO. 5)

(Q₁, T₁) A1/A5 : T_C = 9.41 min.; I₁₀₀ = 4.73 in/hr; Q₁₀₀ = 20.0 cfs

(Q₂, T₂) A6/EX3 : T_C = 9.42 min.; I₁₀₀ = 4.73 in/hr; Q₁₀₀ = 25.6 cfs

$$Q_T = Q_1 + Q_2 \quad (T_C's \text{ ARE EQUAL})$$

$$Q_{100} = 20.0 + 25.6 = 45.6 \text{ cfs} \quad - \text{BASIN A}$$

COMBINE BASINS EX1 + EX2 + BI (VANC. NO. 6)

(Q₃T₃) EX1: T_C = 17.93 min.; I₁₀₀ = 3.10 in/m²/hr; Q₁₀₀ = 182.9 cfs

(Q₂T₂) EX2: T_C = 9.80 min.; I₁₀₀ = 4.60 in/m²/hr; Q₁₀₀ = 18.5 cfs

(Q₁T₁) BI: T_C = 7.92 min.; I₁₀₀ = 5.29 in/m²/hr; Q₁₀₀ = 0.8 cfs

$$Q_T = 0.8 + \left(\frac{7.92}{9.80}\right) 18.5 + \left(\frac{7.92}{17.93}\right) 182.9 = 96.5 \text{ cfs}$$

$$Q_T = 18.5 + \left(\frac{4.60}{5.29}\right) 0.8 + \left(\frac{9.80}{17.93}\right) 182.9 = 119.2 \text{ cfs}$$

$$Q_T = 182.9 + \left(\frac{3.10}{5.29}\right) 0.8 + \left(\frac{3.10}{4.60}\right) 18.5 = \underline{\underline{195.8 \text{ cfs}}}$$

$$\therefore Q_T = 195.8 \text{ cfs}; T_C = 17.93 \text{ min.}$$

TIME IN NATURAL CHANNEL:

$$\begin{aligned} L &= 225' \\ S &= 2.0\% \end{aligned}$$

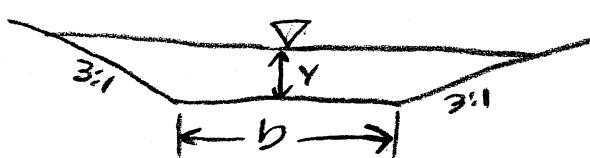
$$Q_{100} = \frac{1.486}{n} AR^{2/3} S^{1/2}$$

n = 0.06 (COUNTY DRG. OSM. HYDRAULIC, TABLE A-5)
(WEEDS, HEAVY BRUSH)

$$AR^{2/3} = \frac{Q_{100} n}{1.486 \sqrt{S}} = \frac{(195.8)(.06)}{1.486 \sqrt{.02}}$$

$$AR^{2/3} = 55.90$$

TRAPEZOIDAL CHANNEL w/ 3:1 SIDE SLOPES



$$A = (by) + \frac{(3y^2)}{2}$$

$$P = b + 2 \sqrt{(3y)^2 + y^2}$$

$$R = \frac{(by) + 3y^2}{b + 2 \sqrt{(3y)^2 + y^2}}$$

$$AR^{4/3} = 55.90$$

$$\text{WITH } b = 10' \rightarrow y = 2.4'$$

(SOLVED BY TRIAL & ERROR)

∴ USE TRAPEZOIDAL CHANNEL WITH 10'
BOTTOM WIDTH, 2.4' DEPTH OF FLOW, 3:1 SIDE
SLOPES

$$V = \frac{Q}{A} = \frac{195.8}{43.75} = 4.5 \text{ FPS} \quad (\text{NON-EROSIVE})$$

$$T_f = \frac{2.25}{4.5 \cdot 60} = 0.83 \text{ min.}$$

$$\text{New } T_c = 17.93 \text{ min.} + 0.83 = 18.76 \text{ min.}$$

COMBINE EX1/EX2/B1 + EX5 + B5 (JUNC. NO. 7)

(Q₁T₁) EX1/EX2/B1: $T_c = 18.76 \text{ min.}; I_{100} = 3.03 \text{ in/hr}; Q_{100} = 195.8 \text{ cfs}$

(Q₁T₁) EX5: $T_c = 9.56 \text{ min.}; I_{100} = 4.70 \text{ in/hr}; Q_{100} = 6.9 \text{ cfs}$

(Q₂T₂) B5: $T_c = 11.37 \text{ min.}; I_{100} = 4.20 \text{ in/hr}; Q_{100} = 1.3 \text{ cfs}$

$$Q_{T_1} = 6.9 + \left(\frac{9.56}{11.37}\right) 1.3 + \left(\frac{9.56}{18.76}\right) 195.8 = 102.8 \text{ cfs}$$

$$Q_{T_2} = 1.3 + \left(\frac{4.20}{4.70}\right) 6.9 + \left(\frac{11.37}{18.76}\right) 195.8 = 126.1 \text{ cfs}$$

$$\underline{Q_{T_3} = 195.8 + \left(\frac{3.03}{4.70}\right) 6.9 + \left(\frac{3.03}{4.20}\right) 1.3 = 201.1 \text{ cfs}}$$

$$\underline{Q_T = 201.1 \text{ cfs}; T_c = 18.76 \text{ min.}}$$

TIME IN NATURAL CHANNEL

$$\frac{L}{S} = \frac{300'}{2.0\%} \quad (\text{SAME CHANNEL SECTION AS ON PAGE 9})$$

$$AR^{2/3} = \frac{Q_{100}(n)}{1.496 \sqrt{S}} = \frac{201.1 (.06)}{1.496 \sqrt{.02}}$$

$$AR^{2/3} = 57.42$$

$$\text{WITH } b = 10' \rightarrow y = 2.4'$$

(SOLVED BY TRIAL & ERROR)

∴ USE TRAPEZOIDAL CHANNEL WITH 10' BOTTOM WIDTH, 2.4' DEPTH OF FLOW, 3:1 SIDE SLOPES

$$\underline{V_{100}} = \frac{Q_{100}}{A} = \frac{201.1}{43.75} = \underline{4.60 \text{ FPS (NON-EROSIVE)}}$$

$$\underline{T_f} = \frac{300}{4.6(60)} = \underline{1.09 \text{ MIN.}}$$

$$\underline{\text{NEW Tc C R.P.O. POND}} = 18.76 + 1.09 = \underline{19.85 \text{ MIN.}}$$

BASIN B2

$$T_c = 9.21 \text{ min.}$$

TIME IN PIPE (18" RCP)

$$L = 32'$$

$$S = 1.0\%$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{5.7}{10.5} = 0.54 \rightarrow d/D = 0.53$$

$$\frac{V_{100}}{V_{CAP}} = 1.04 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{10.5}{1.77} = 5.93 \text{ FPS}$$

$$V_{100} = (1.04) 5.93 = 6.17 \text{ FPS}$$

$$T_f = \frac{32}{6.17 \cdot 60} = 0.09 \text{ min.}$$

$$\underline{\text{NEW } T_c \text{ @ SD INLET}} = 9.21 + 0.09 = \underline{9.30 \text{ MIN.}}$$

COMBINE BASIN B2 + B3 (JUNCTION NODE 8)

$$Q_2 T_2 \quad B2: T_c = 9.30 \text{ min.}; I_{100} = 4.80 \text{ in/hr}; Q_{100} = 5.7 \text{ cfs}$$

$$Q_1 T_1 \quad B3: T_c = 8.29 \text{ min.}; I_{100} = 5.13 \text{ in/hr}; Q_{100} = 4.5 \text{ cfs}$$

$$Q_T = 4.5 + \left(\frac{8.29}{9.30} \right) 5.7 = 9.6 \text{ cfs}$$

$$Q_T = 5.7 + \left(\frac{4.80}{5.13} \right) 4.5 = \underline{9.9 \text{ cfs}}$$

$$\therefore \underline{Q_T = 9.9 \text{ cfs}, T_c = 9.30 \text{ min.}}$$

TIME IN PIPE (18" RCP)

$$L = 212'$$

$$S = 5.0\%$$

$$Q_{100} = 9.9 \text{ cfs}$$

$$Q_{CAP} = 105\sqrt{0.05} = 23.5 \text{ cfs}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{9.9}{23.5} = 0.42 \rightarrow d/D = 0.45$$

$$\frac{V_{100}}{V_{CAP}} = 0.95 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{23.5}{1.77} = 13.28 \text{ f/s}$$

$$V_{100} = 0.95 \times 13.28 = 12.62 \text{ f/s}$$

$$T_f = \frac{212}{1262.60} = 0.28 \text{ min.}$$

$$\underline{\text{NEW } T_c \text{ AT INLET}} = 9.30 + 0.28 = \underline{9.58 \text{ min.}}$$

COMBINE BASINS B2/B3 + B4 (JUNC. NODE 9)

$$Q_1 T_1: B2/B3: T_c = 9.58 \text{ min.}; I_{100} = 4.68 \text{ in/hr}; Q_{100} = 9.9 \text{ cfs}$$

$$Q_2 T_2: B4: T_c = 9.93 \text{ min.}; I_{100} = 4.57 \text{ in/hr}; Q_{100} = 4.0 \text{ cfs}$$

$$Q_T = 9.9 + \left(\frac{9.58}{9.93} \right) 4.0 = \underline{13.8 \text{ cfs}}$$

$$Q_T = 4.0 + \left(\frac{4.57}{4.68} \right) 9.9 = 13.7 \text{ cfs}$$

$$\underline{Q_T = 13.8 \text{ cfs}; T_c = 9.58 \text{ min.}}$$

TIME IN PIPE (18" RCP)

$$\begin{aligned} L &= 39' \\ S &= 2.0 \text{ ft} \end{aligned}$$

$$Q_{100} = 13.8 \text{ cfs}$$

$$Q_{CAP} = 105\sqrt{0.02} = 14.8 \text{ cfs}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{13.8}{14.8} = 0.93 \rightarrow d/D = 0.77$$

$$\frac{V_{100}}{V_{CAP}} = 1.13 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{14.8}{1.13} = 8.36 \text{ FPS}$$

$$\underline{V_{100}} = 1.13(8.36) = \underline{9.45 \text{ FPS}} \quad - \text{USE R.P.RAD TO DISSIPATE VELOCITY}$$

$$T_f = \frac{39}{9.45 \cdot 60} = 0.07 \text{ min.}$$

$$\underline{\text{NEW } T_c \text{ @ R.P.O. RND} = 9.58 + 0.07 = 9.65 \text{ min.}}$$

COMBINE BASINS EX1/EX2/EX5/B1/B5 + B2/B3/B4 (J. N.)

$$Q_2 T_2 \quad EX1 \rightarrow B5 : T_c = 19.85 \text{ min.}; I_{100} = 2.92 \text{ in/HR}; Q_{100} = 201.1 \text{ cfs}$$

$$Q_1 T_1 \quad B2 \rightarrow B4 : T_c = 9.65 \text{ min.}; I_{100} = 4.65 \text{ in/HR}; Q_{100} = 13.8 \text{ cfs}$$

$$Q_T = 13.8 + \left(\frac{9.65}{19.85}\right) 201.1 = \underline{111.6 \text{ cfs}}$$

$$Q_{T2} = 201.1 + \left(\frac{2.92}{4.65}\right) 13.8 = \underline{209.8 \text{ cfs}}$$

$$\underline{Q_T = 209.8 \text{ cfs}; T_c = 19.85 \text{ min.}}$$

TIME IN PIPE (72" RCP)

$$\begin{aligned} L &= 100' \\ S &= 1.0\% \end{aligned}$$

PER CHART 1 ($w/D = 72"$) $\rightarrow Hw/D = 1.1$

$$Hw = 1.1(6') = 6.6'$$

$$\text{PIPE I.E.} = 562.0$$

$$\text{ELEV. @ R/W} = 570.3$$

DIFFERENCE = 8.3' ($> 6.6'$) $\rightarrow \underline{\text{OKAY}}$

USE 72" RCP

$$V = \frac{Q}{A} = \frac{209.8}{28.27} = 7.42 \text{ FPS}$$

$$T_f = \frac{100}{7.42 \cdot 60} = 0.22 \text{ min.}$$

$$\underline{\text{NEW } T_c @ \text{ SOUTH END OF 72'' RCP}} = 19.85 + 0.22 \\ = \underline{\underline{20.07 \text{ min.}}}$$

TIME IN CHANNEL (same channel section
as on Sht. 9)

$$AR^{2/3} = \frac{(209.8)(0.06)}{1,486 \sqrt{0.02}}$$

$$AR^{2/3} = 59.9$$

$$\underline{\text{WITH } b = 10' \rightarrow y = 2.5'}$$

(SOLVED BY TRIAL & ERROR)

\therefore USE TRAPEZOIDAL CHANNEL WITH 10' BOTTOM
WIDTH, 2.5' DEPTH OF FLOW, 3:1 SIDE SLOPES

$$V_{100} = \frac{Q_{100}}{A} = \frac{209.8}{43.75} = 4.80 \text{ FPS (NON-EROSIVE)}$$

$$T_f = \frac{440'}{4.8 \cdot 60} = 1.53 \text{ min.}$$

$$\underline{\text{NEW } T_c @ \text{ JUNCTION W/BASIN B6}} = 20.07 + 1.53 \\ = \underline{\underline{21.60 \text{ min.}}}$$

COMBINE BASINS B6+B7+EX1→B4 (JUNK NO. 11)

- Q.T. B6: $T_c = 12.70 \text{ min.}; I_{100} = 3.90 \text{ in/hr}; Q_{100} = 3.5 \text{ cfs}$
 Q.T. B7: $T_c = 12.74 \text{ min.}; I_{100} = 3.90 \text{ in/hr}; Q_{100} = 3.1 \text{ cfs}$
 Q.T. EX1→B4: $T_c = 21.60 \text{ min.}; I_{100} = 2.77 \text{ in/hr}; Q_{100} = 209.8 \text{ cfs}$

$$Q_T_1 = 3.5 + \left(\frac{12.70}{12.74} \right) 3.1 + \left(\frac{12.70}{21.60} \right) 209.8 = 129.9 \text{ cfs}$$

$$Q_T_2 = 3.1 + \left(\frac{3.90}{3.90} \right) 3.5 + \left(\frac{12.74}{21.60} \right) 209.8 = 130.3 \text{ cfs}$$

$$\underline{Q_T_3 = 209.8 + \left(\frac{2.77}{3.90} \right) 3.5 + \left(\frac{2.77}{3.90} \right) 3.1 = 214.5 \text{ cfs}}$$

$$\therefore \underline{Q_{100} = 214.5 \text{ cfs}}; \underline{T_c = 21.60 \text{ min.}}$$

CHANNEL DESIGN

$$AR^{2/3} = \frac{214.5(.06)}{1.486 \sqrt{0.2}}$$

$$AR^{2/3} = 61.24$$

$$\text{WITH } b = 10' \rightarrow y = 2.5'$$

\therefore USE TRAPEZOIDAL CHANNEL WITH 10' BOTTOM WIDTH, 2.5' DEPTH OF FLOW, 3:1 SIDE SLOPES.

$$\underline{V_{100} = \frac{Q_{100}}{A} = \frac{214.5}{43.75} = 4.90 \text{ fpm (non-erodic)}}$$

COMBINE BASINS C1 & C2 (Junction Node 12)

$Q_2 T_2$ C1: $T_c = 12.03 \text{ min.}$; $I_{100} = 4.04 \text{ in/hr}$; $Q_{100} = 6.3 \text{ cfs}$

$Q_1 T_1$ C2: $T_c = 11.53 \text{ min.}$; $I_{100} = 4.15 \text{ in/hr}$; $Q_{100} = 3.3 \text{ cfs}$

$$Q_{T_1} = 3.3 + \left(\frac{11.53}{12.03} \right) 6.3 = 9.3 \text{ cfs}$$

$$\underline{Q_{T_2} = 6.3 + \left(\frac{4.04}{4.15} \right) 3.3 = 9.5 \text{ cfs}}$$

$$\underline{Q_{100} = 9.5 \text{ cfs}; T_c = 12.03 \text{ min.}}$$

TIME IN PIPE (18" RCP)

$$\begin{aligned} L &= 232' \\ S &= 2.5 \text{ ft} \end{aligned}$$

$$Q_{100} = 9.5 \text{ cfs}$$

$$Q_{CAP} = 105 \sqrt{0.025} = 16.6 \text{ cfs}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{9.5}{16.6} = 0.57 \rightarrow d/D = 0.55$$

$$\frac{V_{100}}{V_{CAP}} = 1.04 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{16.6}{1.77} = 9.37 \text{ fps}$$

$$V_{100} = (1.04)(9.37) = 9.75 \text{ fps}$$

$$T_f = \frac{232}{9.75 \cdot 60} = 0.40 \text{ min.}$$

$$\underline{\text{NEW } T_c \text{ at Junction w/ Basin C4} = 12.03 + 0.40} = 12.43 \text{ min.}$$

COMBINE C1/C2 + C4 (JUNCTION NODE 13)

(Q₂T₂) C1/C2: T_C = 12.43 min.; I₁₀₀ = 3.95 in/hr; Q₁₀₀ = 9.5 cfs

(Q,T) C4: T_C = 10.43 min.; I₁₀₀ = 4.40 in/hr; Q₁₀₀ = 2.3 cfs

$$Q_T = 2.3 + \left(\frac{10.43}{12.43} \right) 9.5 = 10.3 \text{ cfs}$$

$$Q_{T2} = 9.5 + \left(\frac{3.95}{4.40} \right) 2.3 = 11.6 \text{ cfs}$$

$$\underline{Q_T = 11.6 \text{ cfs}; T_C = 12.43 \text{ min.}}$$

TIME IN PIPE (18" RCP)

$$\begin{aligned} L &= 192' \\ S &= 2.5\% \end{aligned}$$

$$Q_{100} = 11.6 \text{ cfs}$$

$$Q_{CAP} = 105 \sqrt{0.025} = 16.6 \text{ cfs}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{11.6}{16.6} = 0.70 \rightarrow d/D = 0.62$$

$$\frac{V_{100}}{V_{CAP}} = 1.07 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{16.6}{1.77} = 9.37 \text{ fps}$$

$$V_{100} = 1.07(9.37) = \underline{10.03 \text{ fps}}$$

$$\overline{T_f} = \frac{192}{10.03 \cdot 60} = \underline{0.32 \text{ min.}}$$

$$\begin{aligned} \text{NEW } T_C \text{ at JUNCTION w/ BASIN C3} &= 12.43 + 0.32 \\ &= \underline{12.75 \text{ min.}} \end{aligned}$$

COMBINE BASINS C1/C2/C4 + C3 + C5 (JUNC. NO. 14)

(Q_{T3}) C1/C2/C4: T_C = 12.75 min.; I₁₀₀ = 3.89_{10^4}; Q₁₀₀ = 11.6 cfs

(Q_{T2}) C3: T_C = 11.12 min.; I₁₀₀ = 4.25_{10^4} / Q₁₀₀ = 3.0 cfs

(Q_{T1}) C5: T_C = 10.75 min.; I₁₀₀ = 4.34_{10^4} / Q₁₀₀ = 3.3 cfs

$$Q_{T1} = 3.3 + \frac{1}{11.12} (3.0 + \frac{1}{12.75} (11.6)) = 16.0 \text{ cfs}$$

$$Q_{T2} = 3.0 + \frac{1}{4.34} (3.3 + \frac{1}{11.12} (11.6)) = 16.3 \text{ cfs}$$

$$\underline{Q_{T3} = 11.6 + \frac{1}{4.25} (3.3 + \frac{1}{12.75} (3.0)) = 17.3 \text{ cfs}}$$

$$\underline{Q_T = 17.3 \text{ cfs}; T_C = 12.75 \text{ min.}}$$

TIME IN PIPE (24" RCP)

$$\begin{matrix} L \\ S \end{matrix} = \begin{matrix} 191 \\ 1.04 \end{matrix}$$

$$Q_{100} = 17.3 \text{ cfs}$$

$$Q_{CAP} = 22.6 \sqrt{0.1} = 22.6 \text{ cfs}$$

$$\frac{Q_{100}}{Q_{CAP}} = \frac{17.3}{22.6} = 0.77 \rightarrow \frac{d}{D} = 0.66$$

$$\frac{V_{100}}{V_{CAP}} = 1.11 \quad V_{CAP} = \frac{Q_{CAP}}{A} = \frac{22.6}{3.14} = 7.20 \text{ f/s}$$

$$V_{100} = 1.11 (7.20) = 7.99 \text{ f/s} \quad (\text{USE } R_1, R_2 \text{ TO DISSIPATE VELOCITY})$$

$$T_f = \frac{191}{7.99 \cdot 60} = 0.40 \text{ min.}$$

$$\begin{aligned} \text{NEW } T_C @ \text{JUNCTION w/ BASIN C6} &= 12.75 + 0.40 \\ &= \underline{\underline{13.15 \text{ min.}}} \end{aligned}$$

COMBINE BASINS C6 + EX6 (VANC. NODE 15)

Q.T. C6: $T_c = 13.51 \text{ min.}; I_{100} = 3.70 \text{ ft}; Q_{100} = 1.8 \text{ cfs}$

Q.T. EX6: $T_c = 13.93 \text{ min.}; I_{100} = 3.70 \text{ ft}; Q_{100} = 84.2 \text{ cfs}$

$$Q_T = 1.8 + \left(\frac{13.51}{13.93} \right) 84.2 = 83.5 \text{ cfs}$$

$$Q_T = 84.2 + \left(\frac{3.70}{3.70} \right) 1.8 = \underline{\underline{86.0 \text{ cfs}}}$$

$$\underline{\underline{Q_T = 86.0 \text{ cfs}; T_c = 13.93 \text{ min.}}}$$

TIME IN NATURAL CHANNEL

$$\begin{aligned} L &= 375' \\ S &= 2.0\% \end{aligned}$$

$$n = 0.035$$

$$\begin{aligned} AR^{2/3} &= \frac{Q_{100}(n)}{1.486 J^5} \\ &= \frac{(86.0)(.035)}{1.486 J^{.02}} \end{aligned}$$

$$AR^{2/3} = 14.32$$

$$\text{WITH } b = 6' \rightarrow y = 1.4'$$

\therefore USE TRAPEZOIDAL CHANNEL WITH 6' BOTTOM WIDTH, FLOOR DEPTH OF 1.4', 3:1 SIDE SLOPES

$$V_{100} = \frac{Q_{100}}{A} = \frac{86.0}{15.75} = 5.5 \text{ f/s}$$

$$T_f = \frac{375}{5.5 \cdot 60} = 1.14 \text{ min.}$$

$$\begin{aligned} \text{NEW } T_c \text{ @ JUNCTION w/ BASIN EX7: } & 13.93 + 1.14 \\ & = \underline{\underline{15.07 \text{ min.}}} \end{aligned}$$

COMBINE BASINS C6/EX6 + EX7 (JUNC. NO. 16)

Q_{2T_2} C6/EX6: $T_C = 15.07 \text{ min.}; I_{100} = 3.49 \text{ ft}; Q_{100} = 86.0 \text{ cfs}$

Q_{1T_1} EX7: $T_C = 10.76 \text{ min.}; I_{100} = 4.31 \text{ ft}; Q_{100} = 6.3 \text{ cfs}$

$$Q_{T_1} = 6.3 + \left(\frac{10.76}{15.07} \right) 86.0 = 67.7 \text{ cfs}$$

$$\underline{Q_{T_2}} = 86.0 + \left(\frac{3.49}{4.30} \right) 6.3 = \underline{91.1 \text{ cfs}}$$

$$\underline{Q_T} = \underline{91.1 \text{ cfs}}; T_C = 15.07 \text{ min.}$$

TIME IN NATURAL CHANNEL

$$\begin{aligned} L &= 400' \\ S &= 2.0\% \end{aligned}$$

$$AR^{2/3} = \frac{Q_{100}(n)}{1.486 JS} \quad n = 0.035$$

$$AR^{2/3} = \frac{(91.1)(0.035)}{1.486 \sqrt{1.02}}$$

$$AR^{2/3} = 15.17$$

$$\underline{\text{WITH } b = 6' \rightarrow y = 1.5'}$$

\therefore USE TRAPEZOIDAL CHANNEL WITH 6' BOTTOM WIDTH, 1.5' PLOW DEPTH, 3:1 SIDE SLOPES

$$V_{100} = \frac{Q_{100}}{A} = \frac{91.1}{15.17} = \underline{5.78 \text{ f/s}}$$

$$T_f = \frac{400}{5.78 \cdot 60} = 1.15 \text{ min.}$$

NEW T_C AT JUNCTION w/ BASIN C1/C5 = $15.07 + 1.15$
 $= \underline{16.22 \text{ min.}}$

COMBINE BASINS C1 → C5 + C6 → EX7 (INC. NO. 17)

Q.T. C1/C5: $T_c = 13.15 \text{ min.}; I_{100} = 3.81 \text{ in.}; Q_{100} = 17.3 \text{ cfs}$

Q.T. C6/EX7: $T_c = 16.22 \text{ min.}; I_{100} = 3.33 \text{ in.}; Q_{100} = 91.1 \text{ cfs}$

$$Q_T = 17.3 + \left(\frac{13.15}{16.22} \right) 91.1 = 91.2 \text{ cfs}$$

$$\underline{Q_T = 91.1 + \left(\frac{3.33}{3.81} \right) 17.3 = 106.2 \text{ cfs}}$$

$$\underline{Q_T = 106.2 \text{ cfs}; T_c = 16.22 \text{ min.}}$$

TOTAL ROUTED 100-YEAR FLOW

BASIN A = 45.6 cfs

BASIN B = 214.5 cfs

BASIN C = 106.2 cfs

TOTAL = 366.3 cfs

MINUS OFF-SITE BASINS (EX1 → EX7 (NOT EX-4))

= 322.6

TOTAL ON-SITE

ROUTED FLOW = 43.7 cfs

MINUS EX. ON-SITE

ROUTED FLOW = 39.8

INCREASE

3.9 cfs

EXIT VELOCITY CALC'S

EXISTING CONDITIONS

BASINS EX1, 2, 3, 4, & 5

$$Q_{100} = 244.4 \text{ cfs} \quad (\text{ROUTING CALC'S})$$

CONVEYANCE = NATURAL CHANNEL

APPROXIMATE GEOMETRY: 3:1 SIDE SLOPES
15' BOTTOM WIDTH (b)
3' DEPTH (y)

$$\text{AREA} = by + 3y^2 \\ = 15(3) + 3(3)^2$$

$$\text{AREA} = 72.0$$

$$V_{100} = \frac{Q_{100}}{A} = \frac{244.4}{72}$$

$$\underline{V_{100} = 3.4 \text{ f/s}} \quad (\text{NON-EROSIVE})$$

BASINS EX6, 7 & 8

$$Q_{100} = 101.2 \text{ cfs} \quad (\text{ROUTING CALC'S})$$

CONVEYANCE = NATURAL CHANNEL

APPROX. GEOMETRY: 10:1 SIDE SLOPES
40' BOTTOM WIDTH (b)
0.5' DEPTH (y)

$$\text{AREA} = by + 10y^2 = (40)(.5) + 10(.5)^2 = 22.5 \text{ sr}$$

$$\underline{V_{100} = \frac{Q_{100}}{A} = \frac{101.2}{22.5} = 4.5 \text{ f/s}} \quad (\text{NON-EROSIVE})$$

EXISTING + PROPOSED CONDITIONBASIN A + B + EX1, 2, 3, 4 & 5

$$Q_{100} = 260.1 \text{ cfs (ROUTING CACCS)}$$

CONVEYANCE = NATURAL CHANNEL

APPROX. GEOMETRY: 3:1 SIDE SLOPES
 15' BOTTOM WIDTH (b)
 3' DEPTH (y)

$$\begin{aligned} \text{AREA} &= by + 3y^2 \\ &= (15)(3) + 3(3)^2 \end{aligned}$$

$$\text{AREA} = 72.0 \text{ SF}$$

$$\frac{V_{100}}{A} = \frac{Q_{100}}{A} = \frac{260.1}{72.0} = \underline{\underline{3.6 \text{ FPS}}}$$

BASIN C + EX6, 7 & 8

$$Q_{100} = 106.2 \text{ cfs (ROUTING CACCS)}$$

CONVEYANCE = NATURAL CHANNEL

APPROX. GEOMETRY: 10:1 SIDE SLOPES
 40' BOTTOM WIDTH (b)
 0.5' DEPTH (y)

$$\begin{aligned} \text{AREA} &= by + 10y^2 \\ &= 40(0.5) + 10(0.5)^2 \end{aligned}$$

$$\text{AREA} = 22.5 \text{ SF}$$

$$\frac{V_{100}}{A} = \frac{Q_{100}}{A} = \frac{106.2}{22.5} = \underline{\underline{4.7 \text{ FPS}}}$$

APPENDIX 6

DETENTION BASIN CALCULATIONS

DETENTION BASIN CALC'S

EXIST. + PROP. CONDITION $Q_{100} = 339.2 \quad 366.3$

EXISTING CONDITION $Q_{100} = 320.0 \quad 345.6$

AMOUNT TO DETAIN = 19.2 CFS 20.7 CFS

→ USE 2 DETENTION BASINS

BASIN #1

→ LOCATE IN LOT 38

AMOUNT TO DETAIN = 5.7 CFS (Q_d)

VOLUME TO DETAIN $\frac{7.2 \text{ CFS}}{60 \text{ MIN}}$

$$V_d = Q_d \times T_c \times 60 \\ = (5.7)(9.58)(60)$$

$$V_d = \frac{(7.2)}{3,280 \text{ SF}} \quad 4,140 \text{ SF}$$

$$T_c = 9.58 \\ (\text{ROUTED } T_c \text{ FOR BL+B3+B4})$$

BASIN DIMENSIONS: LENGTH = 55'
WIDTH = 30'
DEPTH = 20' 2.5'

BASIN INFLOW = 13.8 CFS (ROUTED Q_{ds} BASINS B2, B3, B4)

BASIN OUTFLOW = 7.1 CFS $\frac{6.6 \text{ CFS}}{100}$

DETAINED FLOW = 5.7 CFS 7.2 CFS

OUTLET DEVICE - USE TABLE I 'CATCH BASIN

$$Q_{cap} = C_w P_e d^{3/2} \\ = (3.0)(6)(1)^{3/2}$$

$$Q_{cap} = 18.0 \text{ CFS}$$

$$C_w = 3.0 \text{ (MANUAL)} \\ P_e = (1-C_w)P \\ = (1-0.5)[2(3+5)] \\ P_e = 6 \\ d = 1.0$$

$$18.0 > 13.8 \text{ cfs } (Q_{100})$$

∴ USE TYPE 'I' CATCH BASIN FOR Q_{100} FLOW

Q_{100} PIPE FLOW DESIGN

$$Q_{100} = 13.8 \text{ cfs}$$

→ TRL 24" RCP @ 1.0^od

$$Q_{CAP} = 226 \sqrt{0.1} = 22.6 \text{ cfs}$$

$$22.6 > 13.8 \text{ cfs}$$

∴ USE 24" RCP FOR OUTFLOW PIPE

RESTRICTED FLOW DESIGN

$$Q_{RES} = 7.1 \text{ cfs} \quad \underline{6.6 \text{ cfs}}$$

→ PROVIDE OPENING IN SIDE OF TYPE I' CATCH BASIN

$$Q_{CAP} = C_o A_e \sqrt{2gh} \quad C_o = 0.67 \text{ (MANUAL)}$$

$$\underline{6.6 \text{ f.t}} = 0.6 A_e \sqrt{2(32.2)(5)} \quad g = 32.2 \text{ f.p.s}$$

$$A_e = \underline{1.87 \text{ SF}} - 1.74 \text{ SF} \quad h = 0.5'$$

∴ PROVIDE 1' WIDE BY $\frac{1.74}{1.87}$ HIGH OPENING
IN TYPE I' CATCH BASIN FOR PASSAGE
OF RESTRICTED FLOW.

BASIN #2

→ LOCATE IN REAR OF LOTS 23, 24 & 25

$$\text{AMOUNT TO DETAIN} = \frac{19.2 - 5.7}{20.7 - 7.2} = 13.5 \text{ cfs } (Q_d)$$

VOLUME TO DETAIN

$$V_{dc} = Q_d \times T_c \times 60 \\ = (13.5)(12.75)(60)$$

$$V_{dc} = 10,330 \text{ cft}$$

$$T_c = 12.75 \text{ min.} \\ (\text{ROUTED } T_c \text{ FOR BASIN CS})$$

BASIN DIMENSIONS: LENGTH = 300'
WIDTH = 15'
DEPTH = 2.3'

BASIN INFLOW = 17.3 cfs

BASIN OUTFLOW = 3.8 cfs

DETAINED FLOW = 13.5 cfs

OUTLET DEVICE - USE TYPE I 'CATCH BASIN'

$$Q_{cap} = C_{ci} P_{ed}^{3/2} \\ = (3.0)(6)(1)^{3/2}$$

$$Q_{cap} = 18.0 \text{ cfs}$$

$$18.0 > 17.3$$

$$C_o = 3.0 \text{ (MANUAL)}$$

$$P_e = (1 - C_o) f \\ = (1 - 3.0) / 2(3 + 3)$$

$$P_e = 6 \\ f = 1.0$$

∴ USE TYPE I 'CATCH BASIN FOR Q₁₀₀ FLOW

Q₁₀₀ PIPE FLOW DESIGN

$$Q_{100} = 17.3 \text{ cfs}$$

→ TRY 24" RCP C 1.00

$$Q_{CAP} = 226\sqrt{0.01} = 22.6 \text{ cfs}$$

$$22.6 > 17.3$$

∴ USE 24" RCP FOR OUTFLOOR PIPE

RESTRICTED FLOW DESIGN

$$Q_{RES} = 3.8 \text{ cfs}$$

→ PROVIDE OPENING IN SIDE OF CATCH BASIN

$$Q_{CAP} = C_o A_e \sqrt{2g h}$$

$$3.8 = (0.6) A_e \sqrt{2(32.2)(0.5)}$$

$$A_e = 1.00 \text{ sft}$$

$$C_o = 0.67 \text{ (MANUAL)}$$

$$g = 32.2 \text{ FAS}$$

$$h = 0.5'$$

∴ PROVIDE 1.00' WIDE BY 1.0' HIGH OPENING
IN TYPE I CATCH BASIN FOR PASSAGE OF
RESTRICTED FLOW.

APPENDIX 7

BMP SIZING CALCULATIONS

BMP SIZING CALCULATIONS - DRAIN INSERTS

BASIN NUMBER	AREA (acres)	C	I _{wq} (in/hr)	Q _{wq} (cfs)	INLET		FILTER INSERT MODEL NO.*	TOTAL FILTER CAPACITY (cfs)
					TYPE	LENGTH		
A1	0.55	0.80	0.2	0.09	Type 'B' curb inlet	L = 14'	FGP-12.0CI	4.20
A2	1.27	0.53	0.2	0.13	Type 'B' curb inlet	L = 18'	FGP-16.0CI	5.60
A3	1.64	0.53	0.2	0.17	Type 'B' curb inlet	L = 20'	FGP-18.0CI	6.20
A4	1.06	0.50	0.2	0.11	Type 'B' curb inlet	L = 16'	FGP-14.0CI	4.90
A5	3.28	0.55	0.2	0.36	Type 'B' curb inlet	L = 10'	FGP-8.0CI	2.90
A6	0.68	0.70	0.2	0.10	Type 'B' curb inlet	L = 20'	FGP-18.0CI	6.20
B2	1.81	0.66	0.2	0.24	Type 'B' curb inlet	L = 7'	FGP-6.0CI	2.20
B3	1.76	0.50	0.2	0.18	Type 'B' curb inlet	L = 17'	FGP-16.0CI	5.60
B4	1.60	0.55	0.2	0.18	Type 'B' curb inlet	L = 20'	FGP-18.0CI	6.20
B6	1.71	0.53	0.2	0.18	Type 'B' curb inlet	L = 5'	FGP-48CI	1.50
C1	2.84	0.55	0.2	0.31	Type 'B' curb inlet	L = 21'	FGP-18.0CI	6.20
C2	1.41	0.57	0.2	0.16	Type 'B' curb inlet	L = 17'	FGP-16.0CI	5.60
C3	1.28	0.55	0.2	0.14	Type 'B' curb inlet	L = 16'	FGP-14.0CI	4.90
C4	1.02	0.52	0.2	0.11	Type 'B' curb inlet	L = 13'	FGP-12.0CI	4.20
C5	1.44	0.52	0.2	0.15	Type 'B' curb inlet	L = 17'	FGP-16.0CI	5.60

Note: basins not shown herein do not have inlets proposed for runoff collection.

* All models shown are "Flo-Gard +Plus" manufactured by Kristar Enterprises.

See "Drainage Study for Fuerte Ranch Estates", prepared by Polaris Development Consultants, dated 05/01/07, for more detail on the drainage figures shown above.
See next sheet for sample calculations.

FILTER INSERT SIZING - SAMPLE CALC'S

BASIN A1

$$\begin{aligned} \text{AREA} &= 0.55 \text{ AC} \\ C &= 0.80 \end{aligned} \quad \left. \begin{array}{l} \\ \end{array} \right\} \text{(FROM SHEET 10)}$$

$I_{wa} = 0.2 \text{ in/hr}$ (PER COUNTY SUSMID MANUAL)

$$\begin{aligned} Q_{wa} &= AC I_{wa} \\ &= (0.55)(0.80)(0.20) \end{aligned}$$

$$\underline{Q_{wa} = 0.09 \text{ cfs}}$$

INLET = 14' TYPE 'B' CURB INLET (SEE SH. 1 OF APPENDIX 3)

FILTER INSERT : KRISTAR FLOGARD + PLUS
MODEL NO. FGP-12.0CI

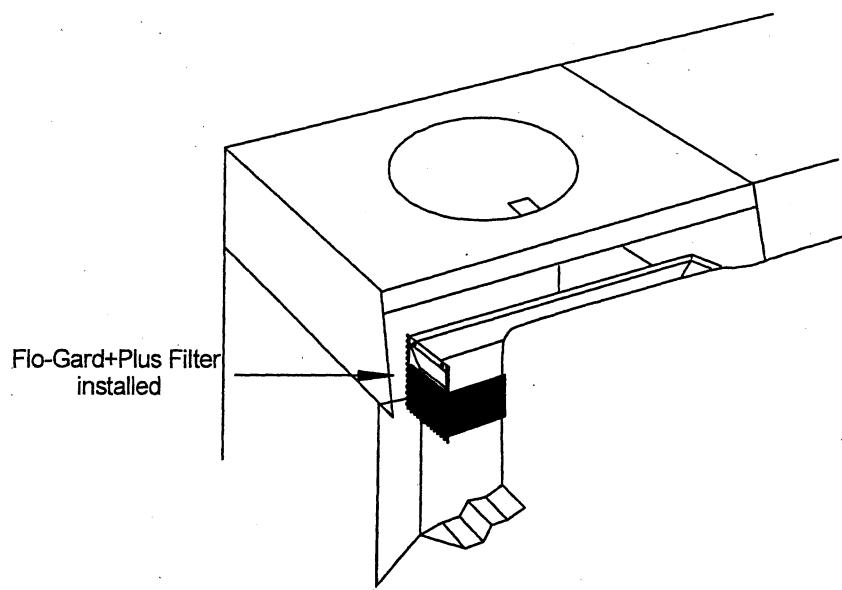
FILTER CAPACITY = 4.20 cfs (PER SPEC. SH.)

$$4.20 > 0.09$$

BYPASS CAPACITY = 26.2 cfs (PER SPEC. SH.)

$$26.2 > Q_{100} \text{ OR } 2.2 \text{ cfs}$$

∴ USE KRISTAR FLOGARD + PLUS FILTER INSERT
MODEL NO. FGP12.0CI



SPECIFIER CHART

Model No.	Inlet Width (in)	Solids Storage Capacity (cu ft)	Filtered Flow (cfs)	Total Bypass Cap. (cfs)
FGP-24CI	24	0.9	0.8	5.6
FGP-30CI	30	1.1	1.0	6.7
FGP-36CI	36	1.4	1.2	7.9
FGP-42CI	42	1.6	1.4	8.8
FGP-48CI	48	1.9	1.5	9.9
FGP-5.0CI	60	2.3	1.8	11.6
FGP-6.0CI	72	2.8	2.2	13.8
FGP-7.0CI	84	3.2	2.5	15.9
FGP-8.0CI	96	3.7	2.9	18.0
FGP-10.0CI	120	4.6	3.5	21.9
FGP-12.0CI	144	5.6	4.2	26.2
FGP-14.0CI	168	6.5	4.9	30.1
FGP-16.0CI	192	7.5	5.6	34.4
FGP-18.0CI	216	8.3	6.2	38.2
FGP-21.0CI	252	9.7	7.2	44.3
FGP-28.0CI	336	13.0	9.5	58.6

NOTES:

1. Storage capacity reflects 80% of maximum solids collection prior to impeding filtering bypass.
2. Filtered flow rate includes a safety factor of 2.
3. Flo-Gard+Plus Catch Basin Filter inserts are available in the standard sizes (see above) or in custom sizes. Call for details on custom size inserts.
4. Available with recessed mount package including fg tray allowing maintenance access from manhole.
5. Flo-Gard+Plus filter inserts should be used in conjunction with a regular maintenance program. Refer to manufacturer's recommended maintenance guidelines.

FLO-GARD™ +PLUS
CATCH BASIN FILTER INSERT
(Curb Mount)
CURB INLET

KriStar Enterprises, Inc., Santa Rosa, CA (800) 579-8819

05/04

APPENDIX 8

COUNTY OF SAN DIEGO DRAINAGE DESIGN MANUAL CHARTS/FIGURES/TABLES

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

NRCS Elements	Land Use	Runoff Coefficient "C"				Soil Type
		% IMPER.	A	B	C	
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	D
Low Density Residential (LDR)	Residential, 1.0 DUA or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DUA or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DUA or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DUA or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DUA or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DUA or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DUA or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DUA or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DUA or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the previous runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DUA = dwelling units per acre

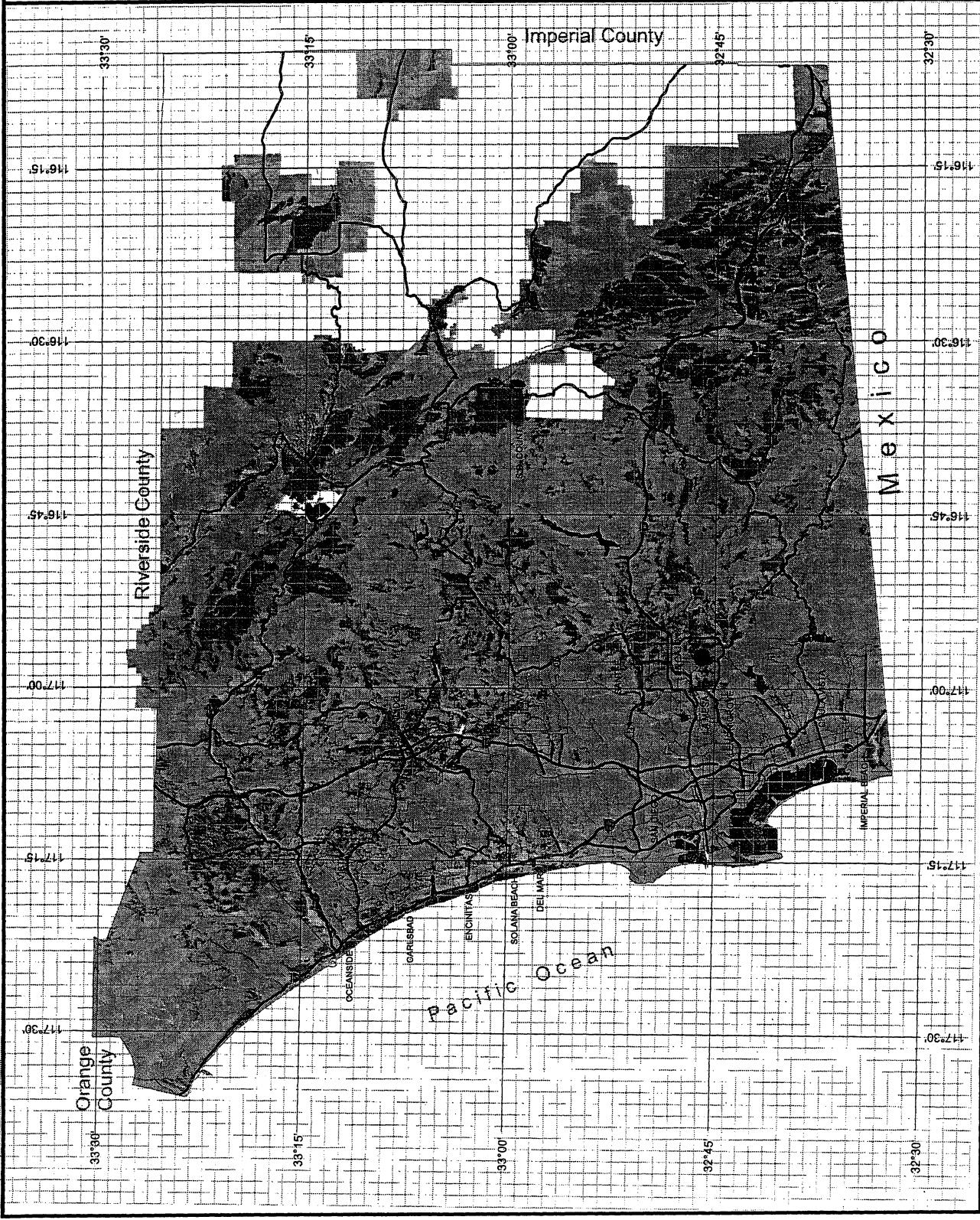
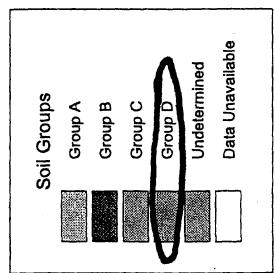
NRCS = National Resources Conservation Service

County of San Diego Hydrology Manual



Soil Hydrologic Groups

Legend



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Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

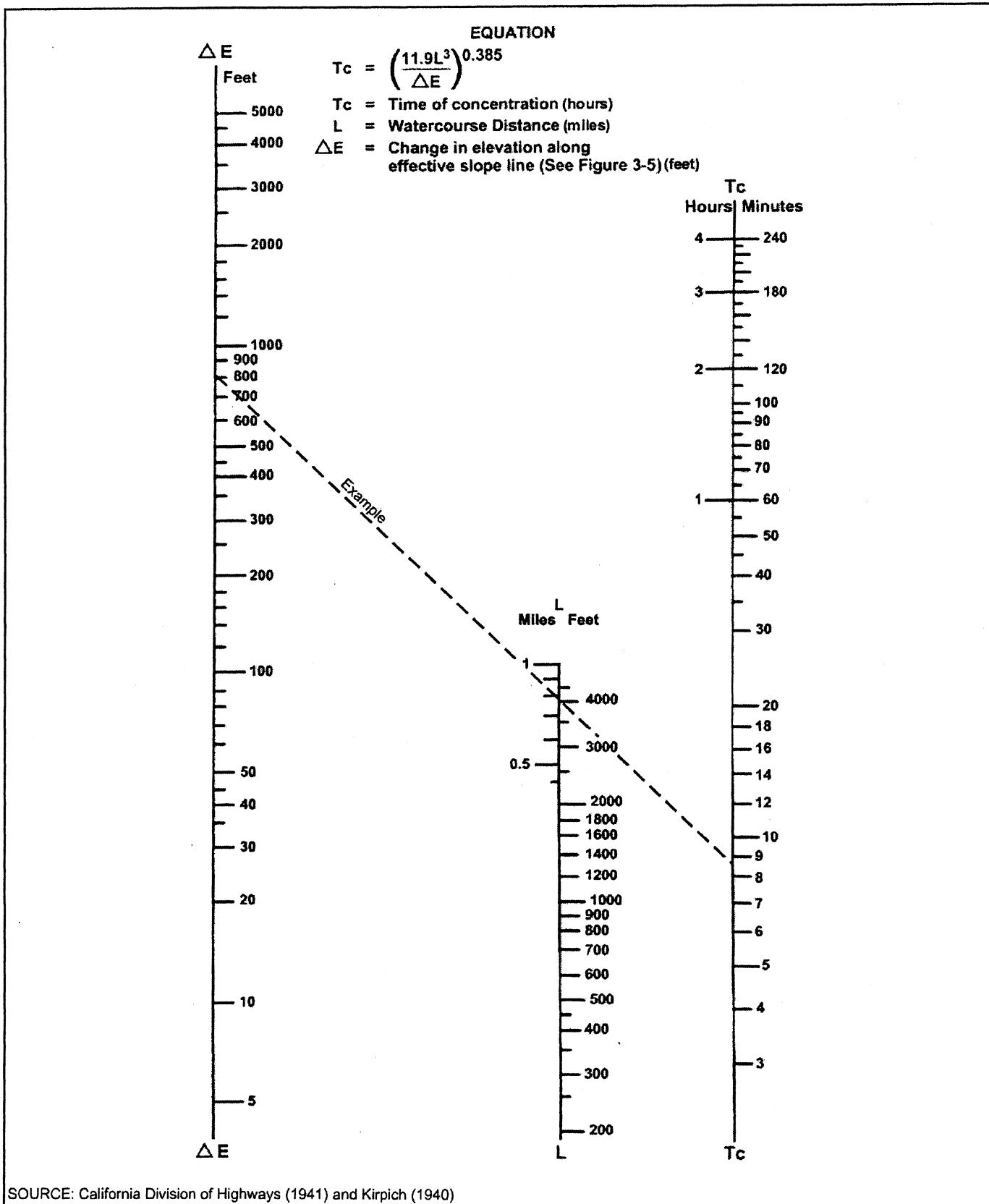
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

**MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)**

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i										
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

F I G U R E

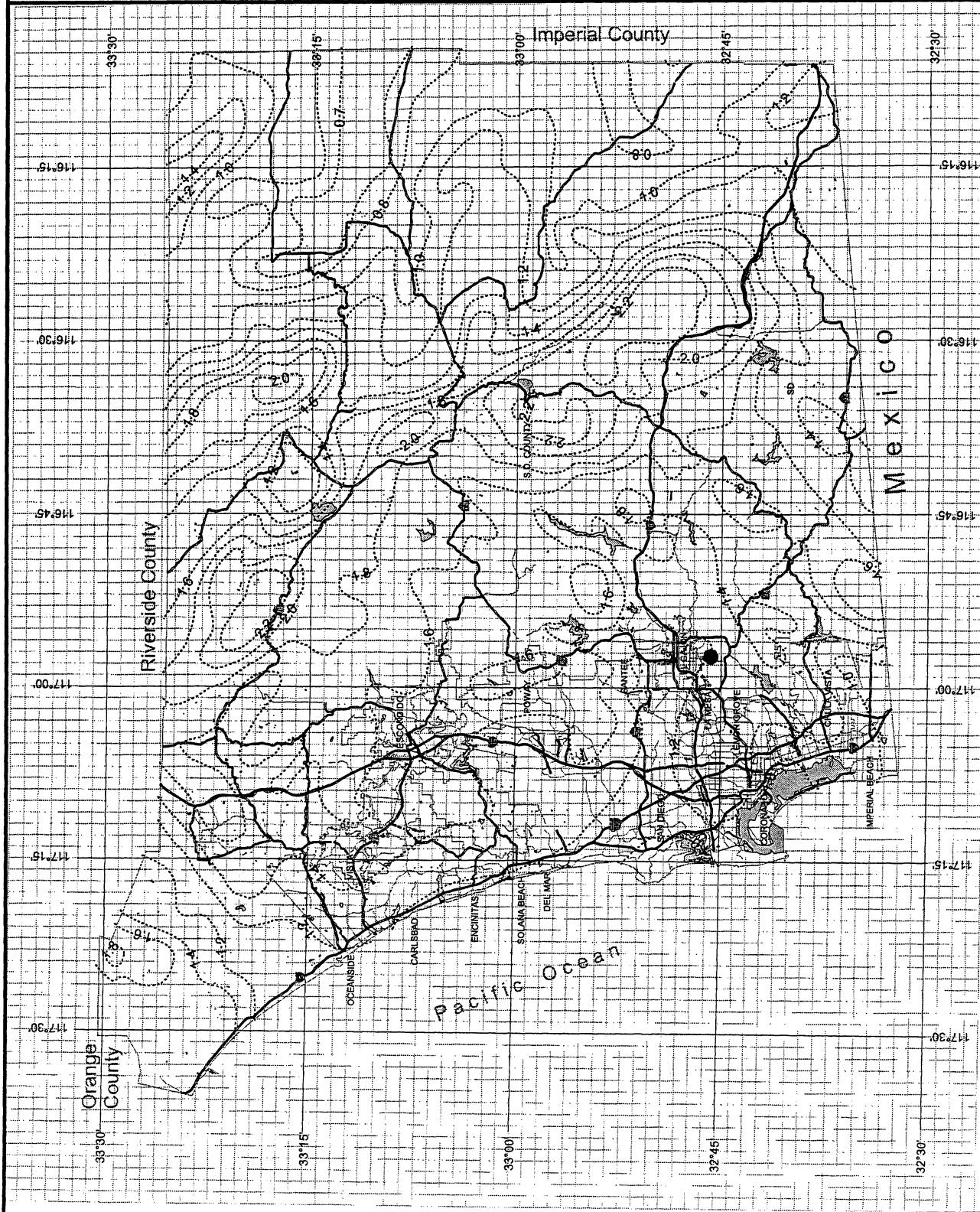
3-4

County of San Diego Hydrology Manual



Rainfall Isopluvials

2 Year Rainfall Event - 6 Hours



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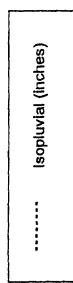
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County of San Diego Hydrology Manual



Rainfall Isopluvials

2 Year Rainfall Event - 24 Hours



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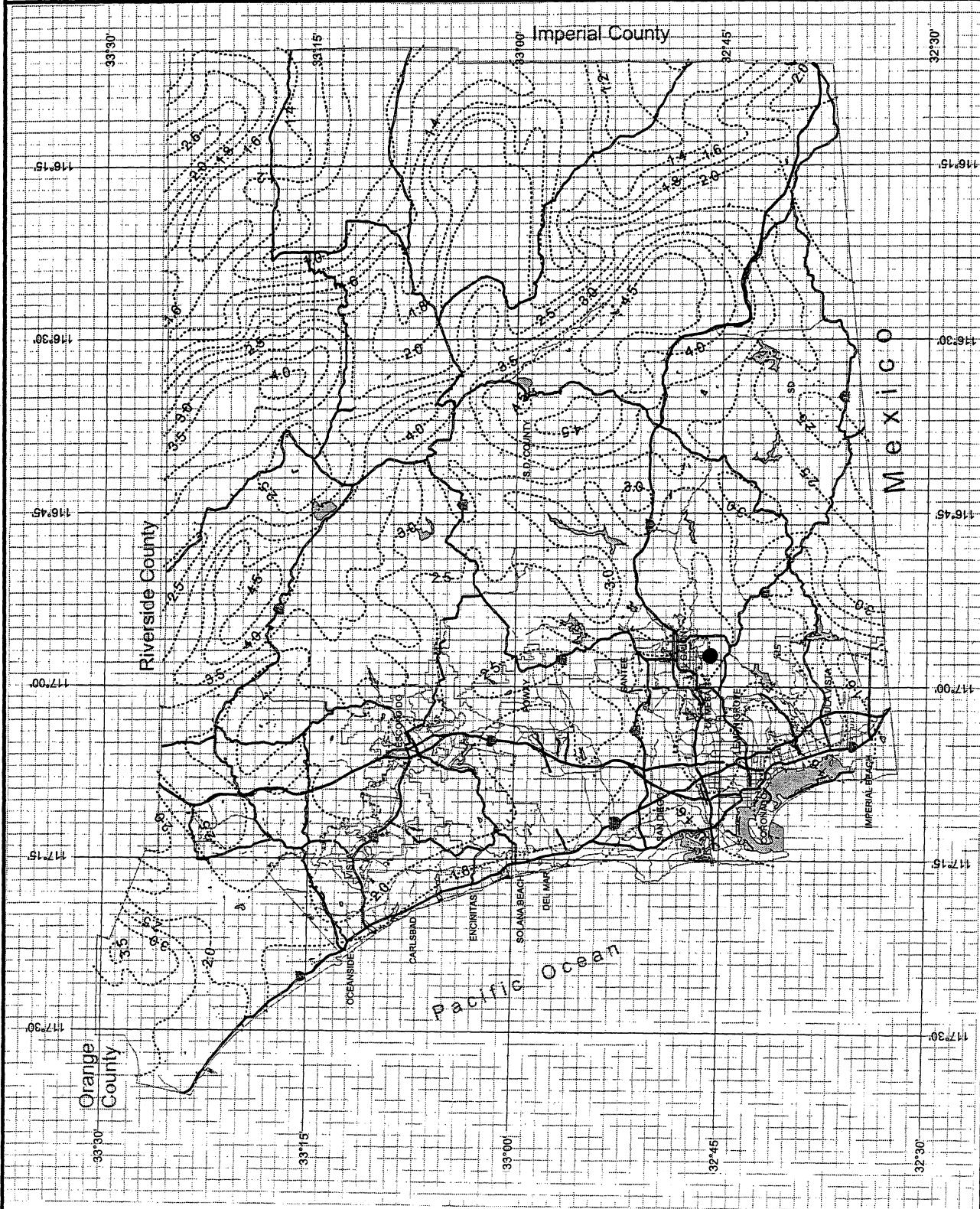
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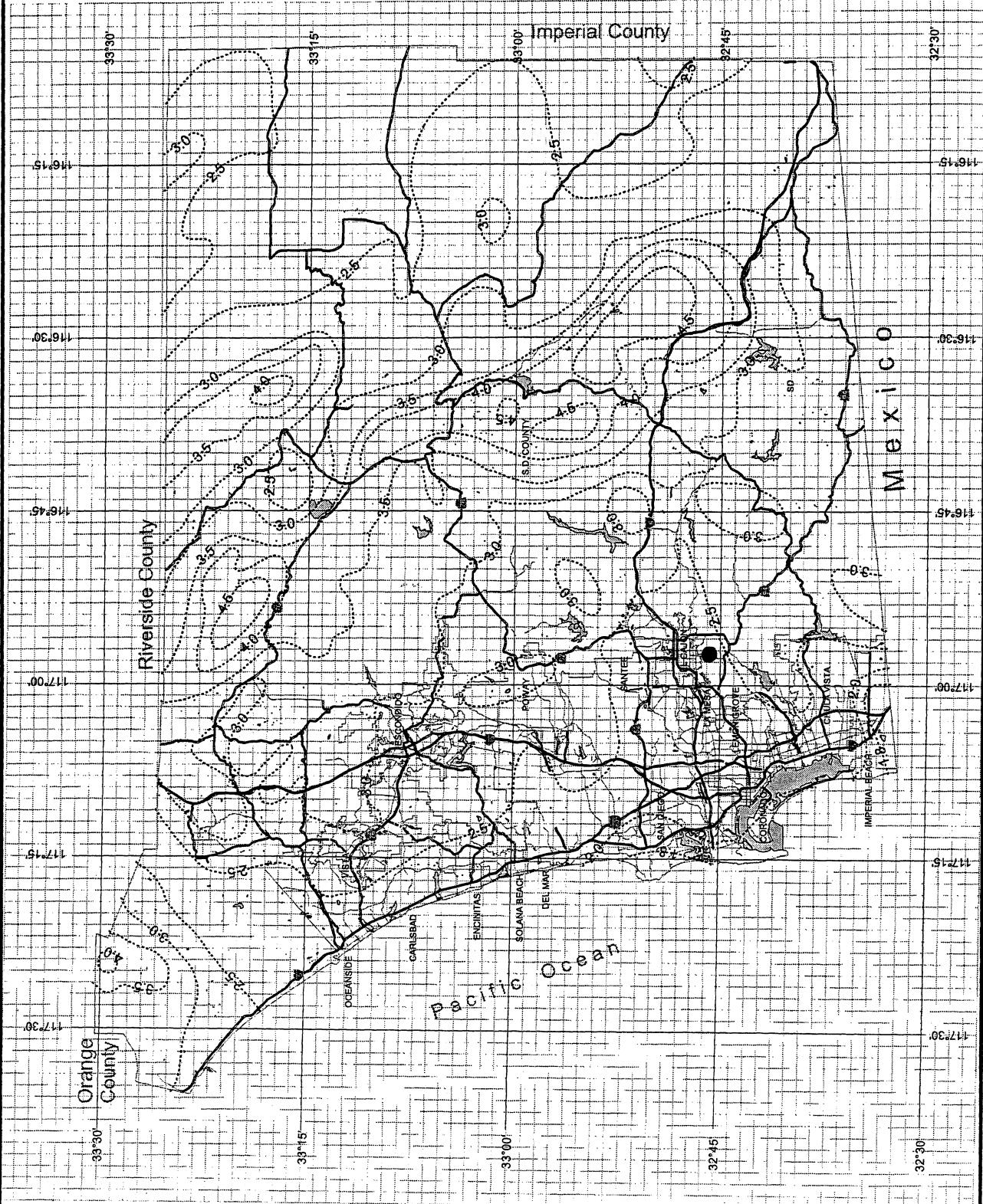
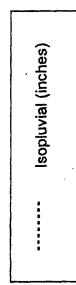


County of San Diego Hydrology Manual



Rainfall Isopluvials

50 Year Rainfall Event - 6 Hours



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Rainfall Isopluvials

50 Year Rainfall Event - 24 Hours

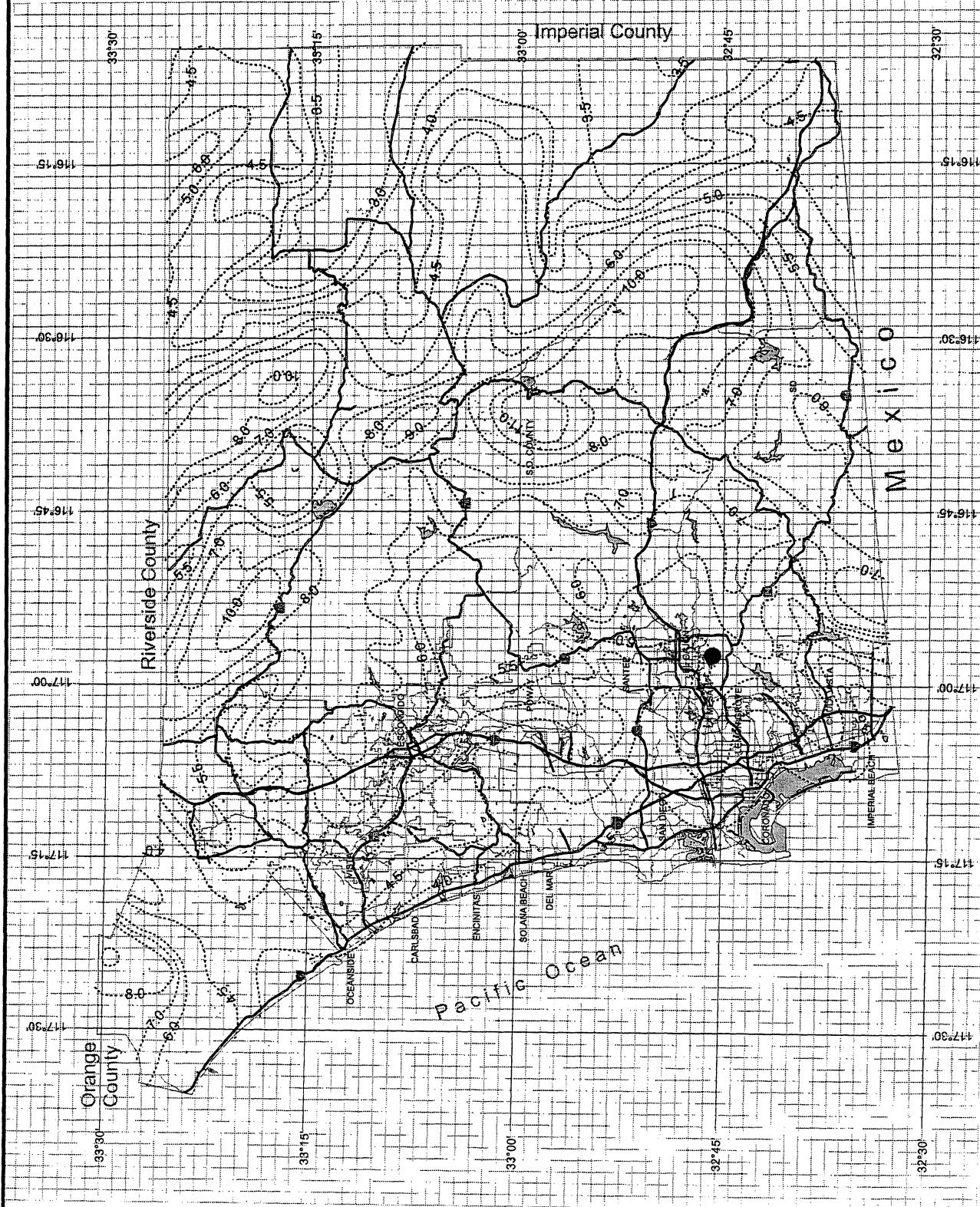


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County of San Diego Hydrology Manual



Rainfall Isophluvials

100 Year Rainfall Event - 6 Hours

Isophluvial (Inches)



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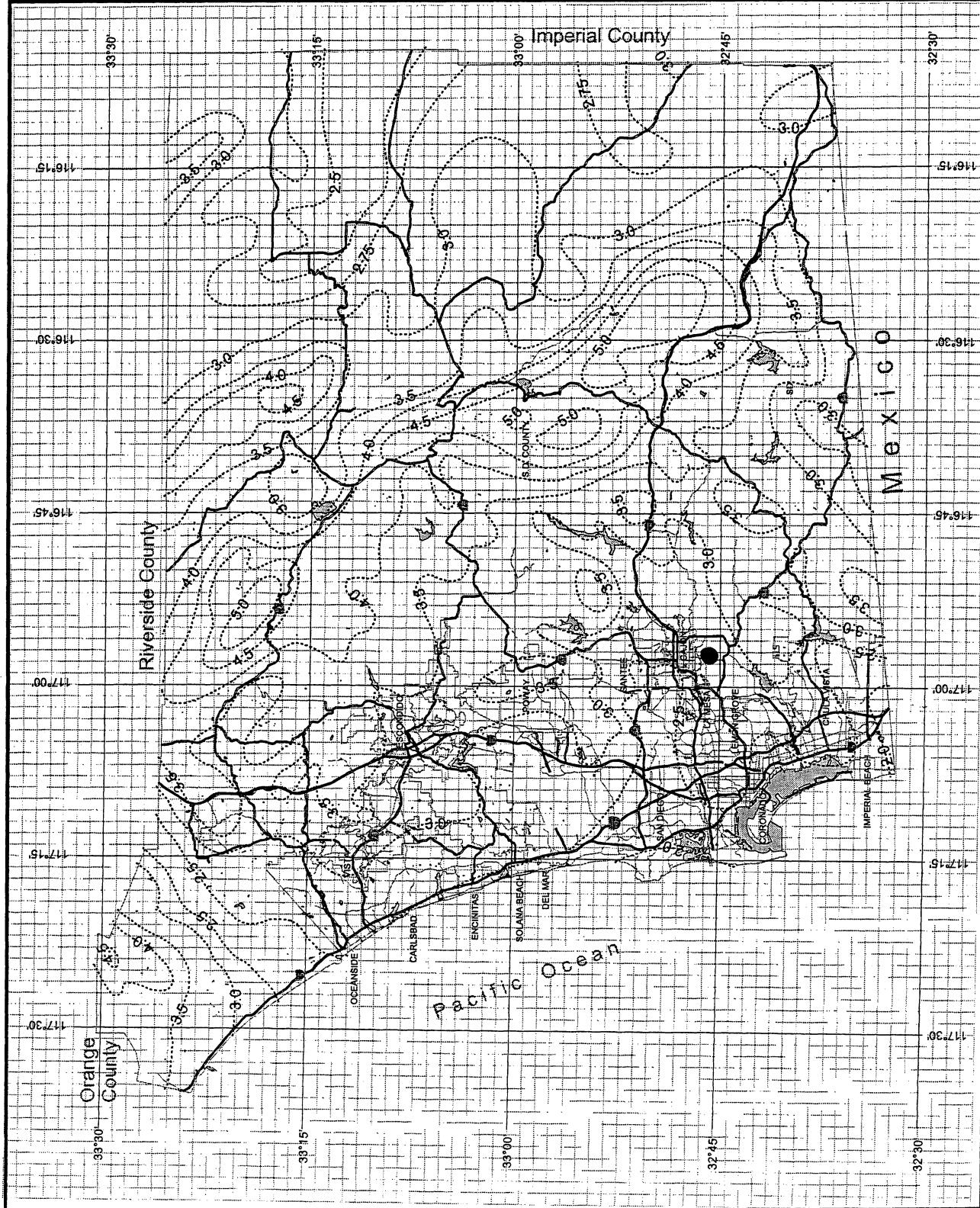
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3 Miles



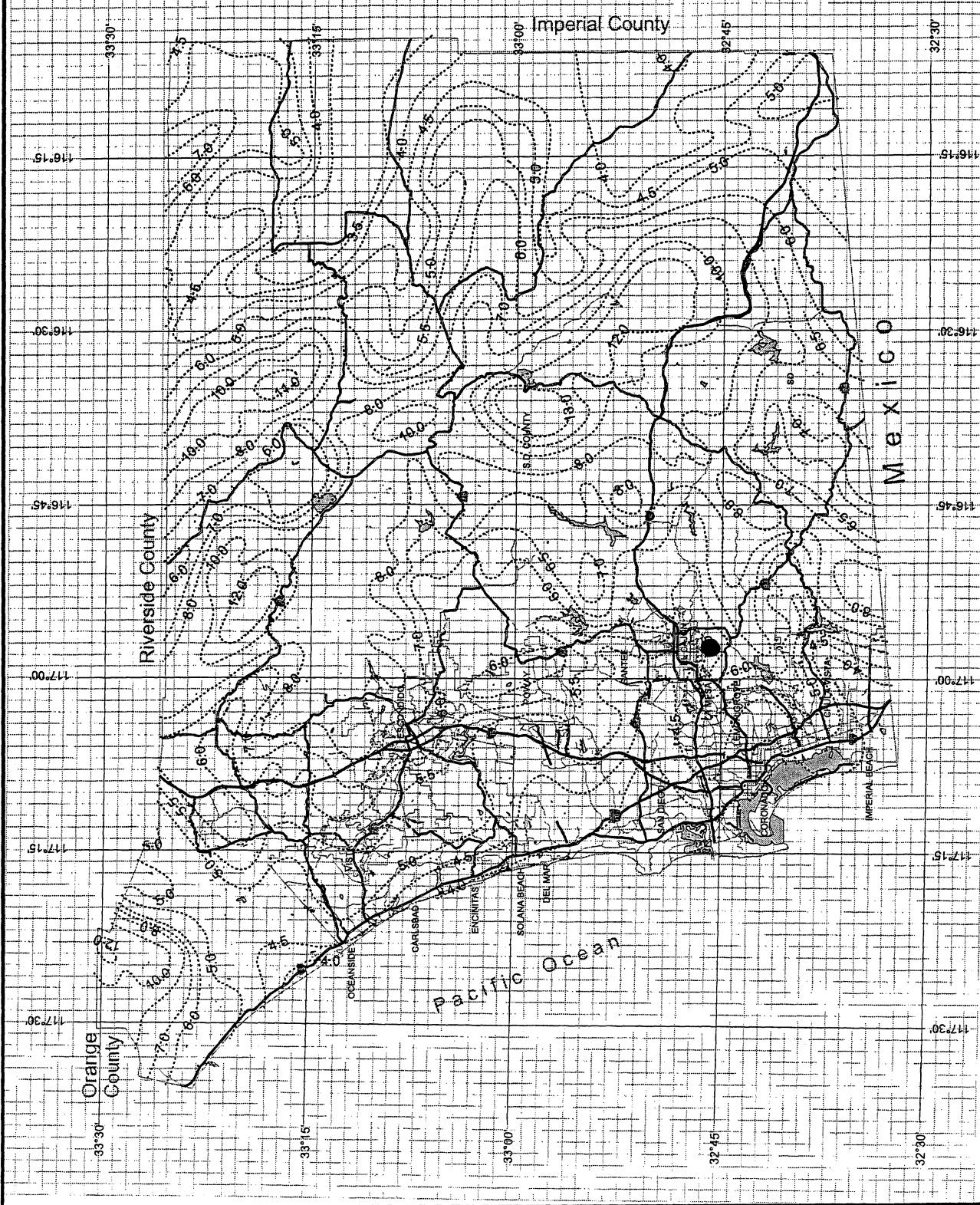
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Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

..... Isopluvial (Inches)



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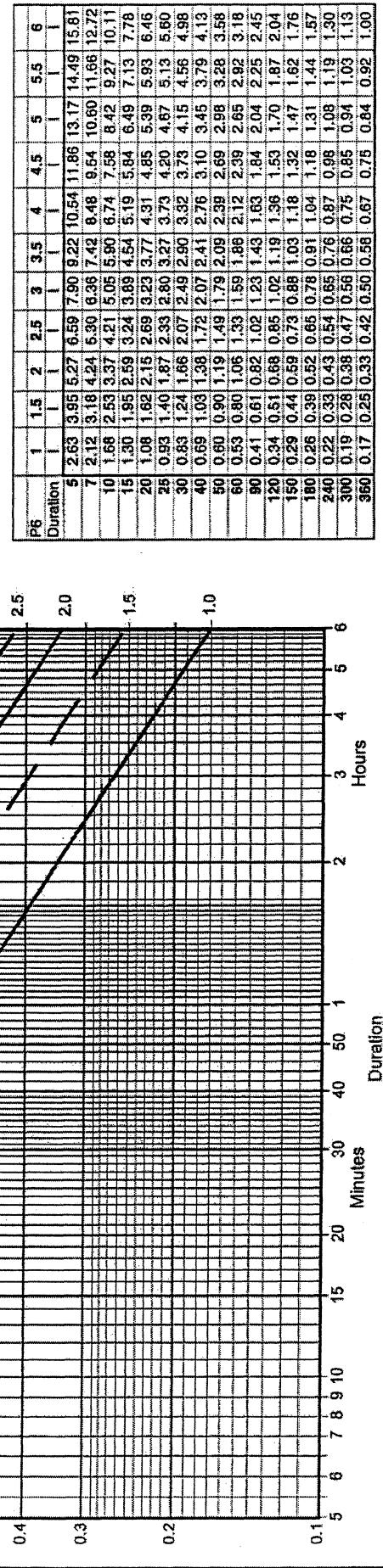
Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 2 year
 (b) $P_6 = \underline{1.2}$ in., $P_{24} = \underline{1.8}$ in.
 (c) Adjusted $P_6^{(2)} = \underline{1.1}$ in.
 (d) $t_x = \underline{\quad}$ min.
 (e) $I = \underline{\quad}$ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.



FIGURE

Intensity-Duration Design Chart - Template

3-1

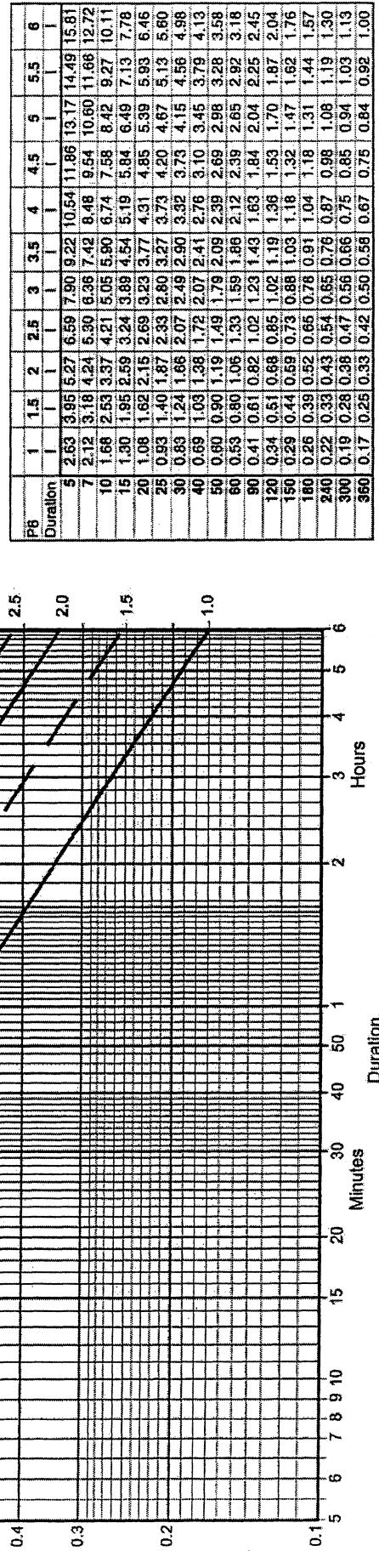
Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 50 year
 (b) $P_6 = \underline{2.4}$ in., $P_{24} = \underline{5.5}$ in.
 (c) Adjusted $P_6^{(2)} = \underline{2.5}$ in.
 (d) $t_X = \underline{\quad}$ min.
 (e) $I = \underline{\quad}$ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.



FIGURE

Intensity-Duration Design Chart - Template

3-1

Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

$$(a) \text{ Selected frequency } 100_{\text{year}}$$

$$(b) P_6 = 2.7 \text{ in., } P_{24} = 5.5$$

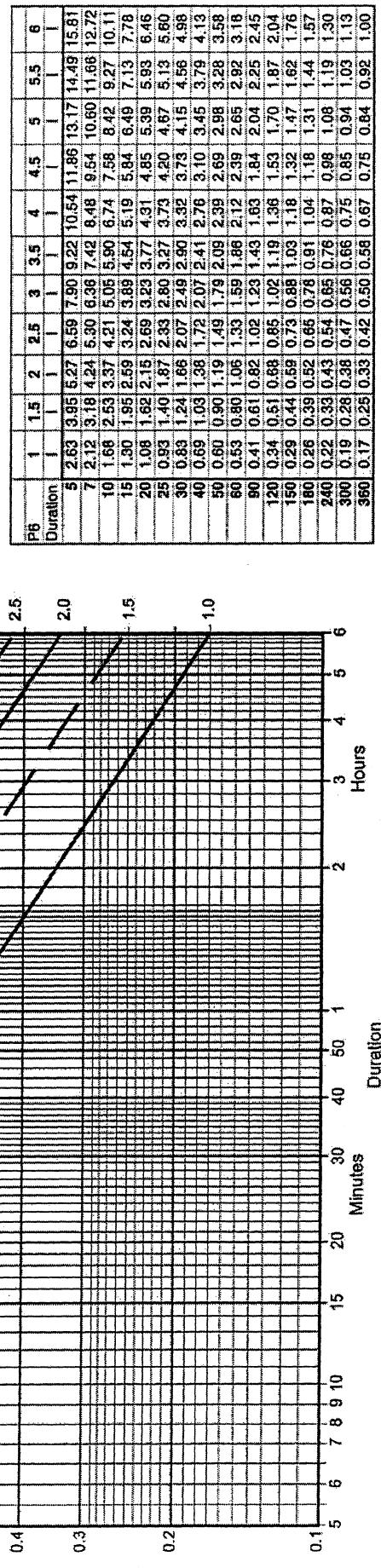
$$\text{Adjusted } P_6^{(2)} = \frac{P_6}{P_{24}} = \frac{2.7}{5.5} = 49\%^{(2)}$$

$$(c) \text{ Adjusted } P_6^{(2)} = \text{ ____ in.}$$

$$(d) I_x = \text{ ____ min.}$$

$$(e) I = \text{ ____ in./hr.}$$

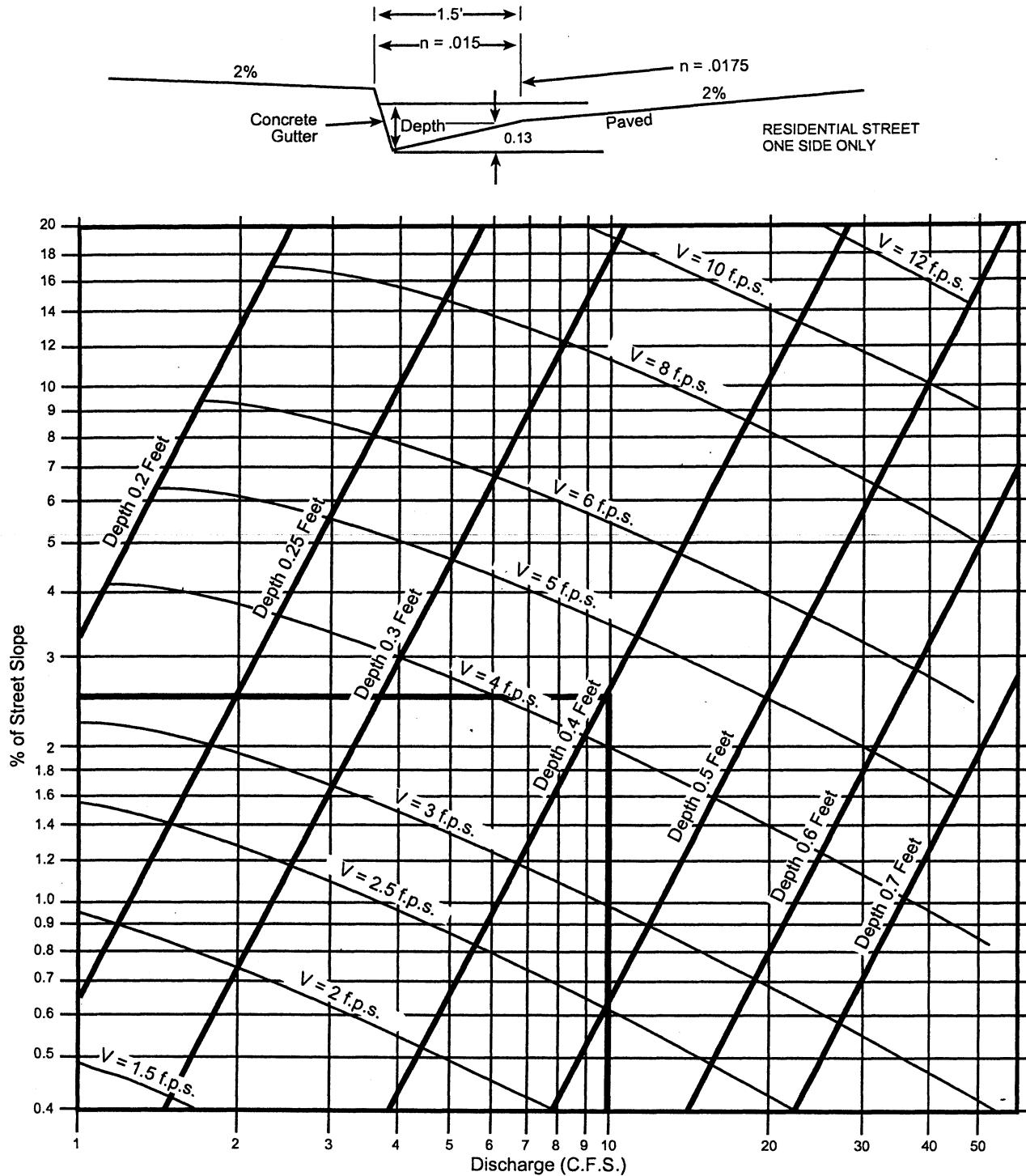
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.



FIGURE

Intensity-Duration Design Chart - Template

3-1



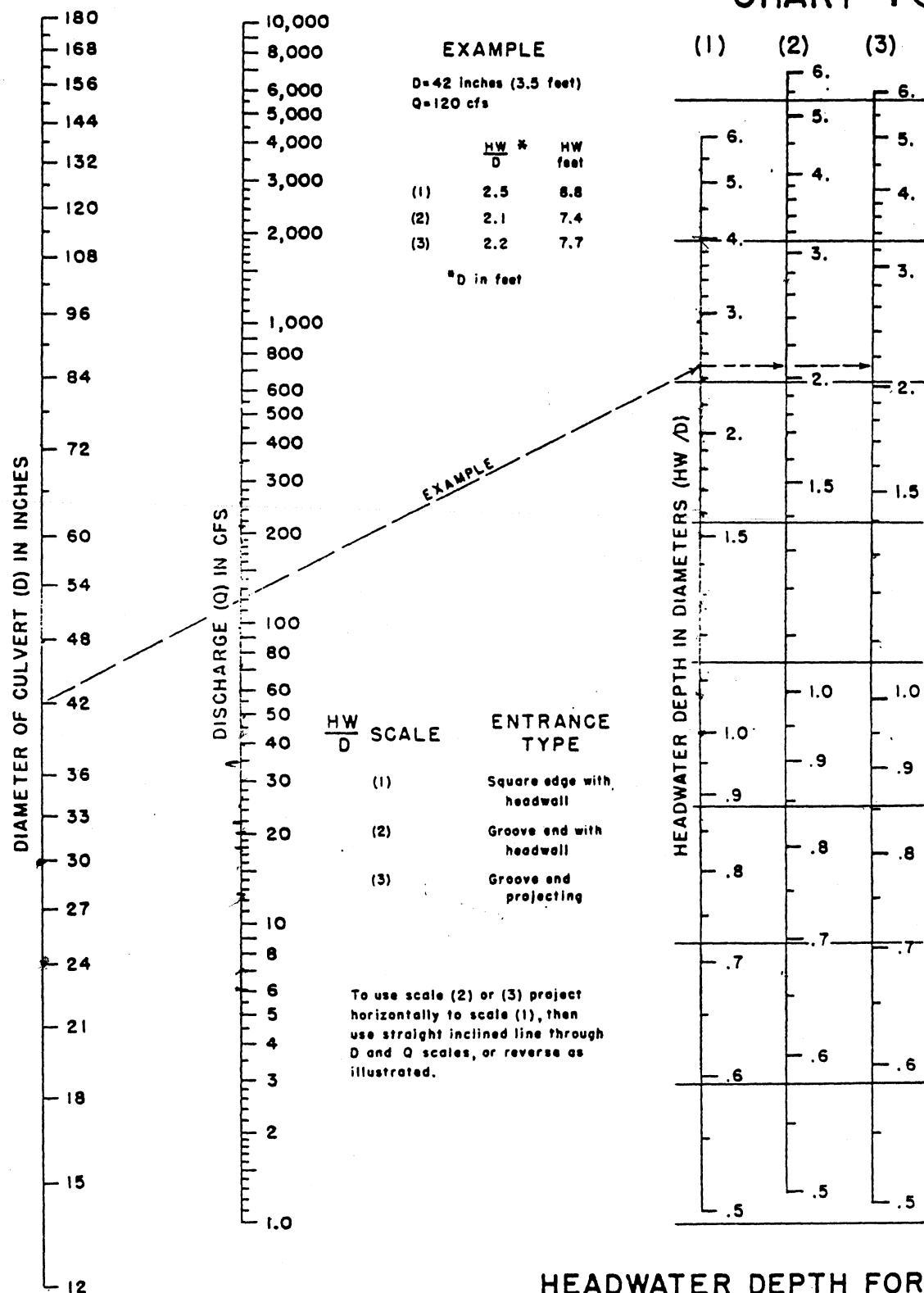
SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE

Gutter and Roadway Discharge - Velocity Chart

3-6

CHART 1



HEADWATER DEPTH FOR
CONCRETE PIPE CULVERTS
WITH INLET CONTROL

Figure 2-5

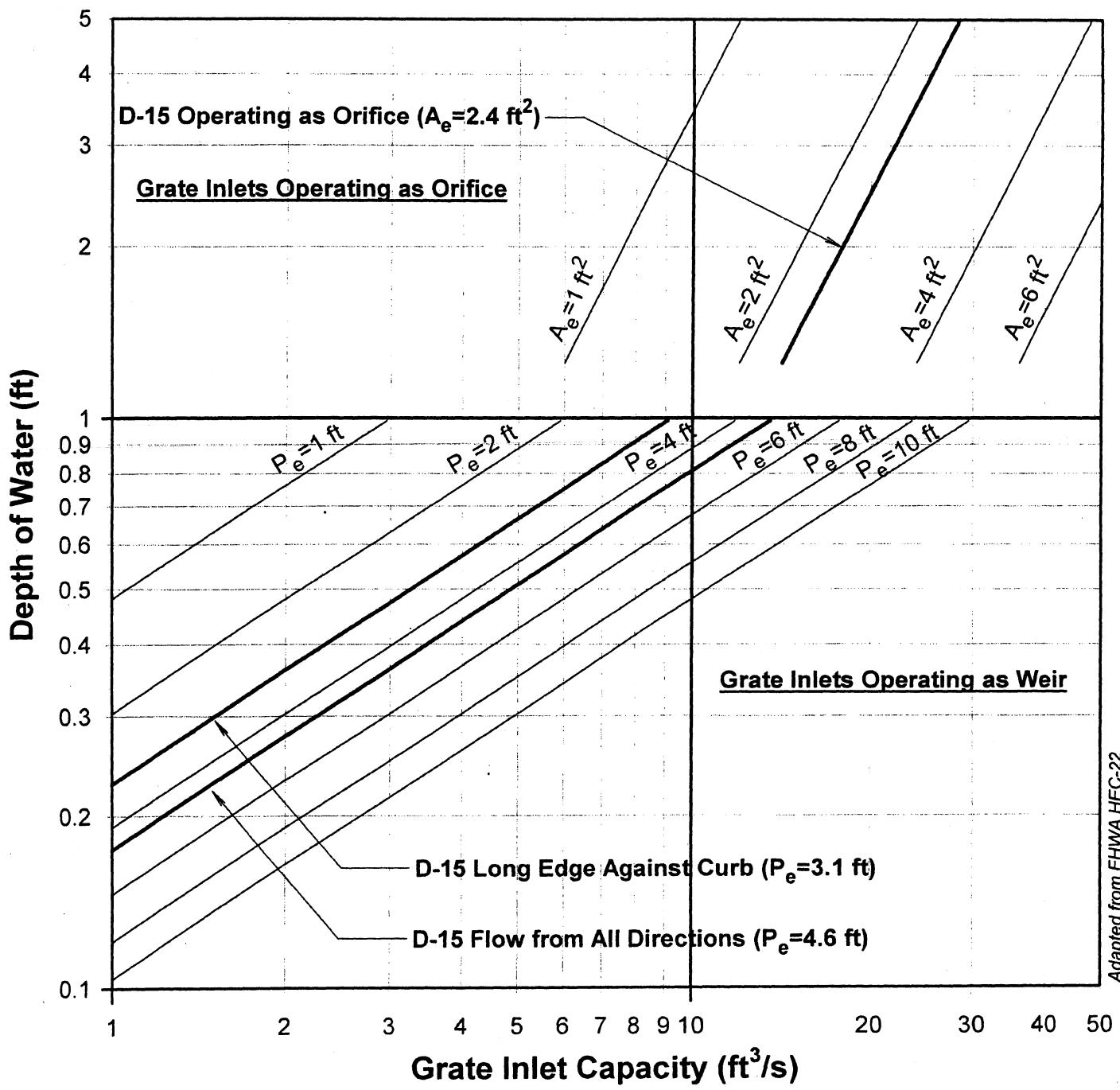


Figure 2-5 Capacity of Grate Inlets in Sump Locations